3. Analysis and Findings

As information was collected and reviewed, the study team analyzed the data and produced findings with respect to the I-95 corridor. The analysis began with a look at current land use and potential economic growth along the corridor in Hanover County and the Town of Ashland. Findings were developed with respect to the existing corridor, and these findings were supplemented by input from the stakeholders of this study. Traffic data, crash data, and geometric deficiencies were then analyzed and more specific findings were obtained. These results led to the development of recommended solutions for specific mainline and interchange capacity improvements.

3.1 Existing Corridor

In Hanover County and Ashland, Virginia, a 4-lane section of I-95 was built in the late 1950's and early 1960's as a north-south route, parallel to the aging U.S. Route 1. This new interstate highway was part of a burgeoning nationwide system of freeways for interstate travel, commerce, and national defense. Over the decades, this section of I-95 has been widened as local, regional, and interstate traffic has grown. The current 6-lane section carries many more vehicles, and especially more trucks, than the original planners and designers envisioned.

Making use of the photogrammetric mapping, **Figures 3-1, 3-2, and 3-3** show the study area corridor and include selected photographs from the photo inventory performed during this study. Referring to the figures, the section of I-95 under study runs approximately 13.5 miles, from just south of the Route 802 (Lewistown Road) interchange, to the North Anna River, approximately 3 miles north of Route 30 and Kings Dominion. The exits to Route 802, Route 54, and Route 30 serve industrial, commercial, and residential destinations. Much of the traffic on I-95 is inter-regional, that is, many of the motorists are traveling through Hanover County and the Town of Ashland to reach destinations in major urban centers along the East Coast.

Despite urban-like freeway through traffic volumes, this corridor is considered rural with respect to land use. The Richmond Urban Area, as defined by the Metropolitan Planning Organization (MPO), extends from Richmond to the I-295 interchange, approximately 5 miles south of this corridor. However, employment and population growth is spreading northward.

Recent articles in the *Richmond Times-Dispatch* point to development growth along I-95. An August 4, 2002 article on development at the Atlee-Elmont exit, just south of Lewistown Road, says “interchange location fuels building boom.” Other articles have highlighted developments and potential growth at the Route 802 and Route 54 interchanges. On March 6, 2003, *Hanover Online* described a proposed 230-acre mixed-use site just east of the Route 54 interchange. In the next 20 years, Richmond's urbanized area boundary will likely move north, well into Hanover County and into the Town of Ashland. For the purposes of the analysis during this study, the TAC agreed that by 2025, the Urban Area boundary would be just north of the Route 54 interchange.

Figure 3-1

I-95 Corridor – Sliding Hill Road Interchange (Exit 86) to Route 54 (Ashland) Interchange (Exit 92)

I-95 southbound at Lewistown Road bridge

Route 802 (Lewistown Road) Interchange (Exit 89)

I-95 northbound at Lewistown Road exit

Figure 3-2

I-95 Corridor – Route 54 (Ashland) Interchange (Exit 92) to Mainline at Old Ridge Road Overpass

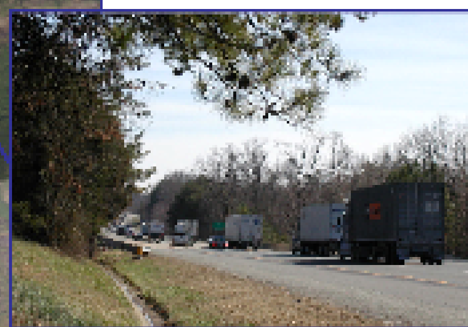
I-95 southbound at Ashland exit

I-95 northbound at Ashland exit

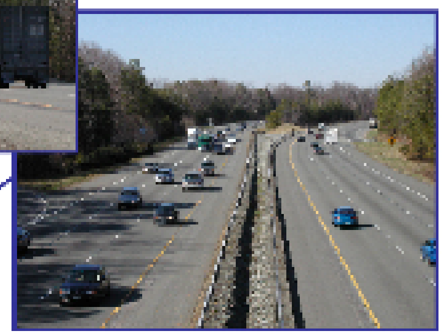
Route 54 (Ashland) Interchange (Exit 92)

Figure 3-3

I-95 Corridor - Mainline at Pamunkey River to Caroline County Line



I-95 southbound at Hanover County line



I-95 northbound from Route 30 bridge

Route 30 Interchange (Exit 98)

I-95 northbound at Route 30 exit

I-95 northbound along mainline

3.1.1 Hanover County

Hanover County is one of the fastest growing counties in Virginia. Many tourists visit the County, accessing historic sites and the Kings Dominion theme park from the I-95 interchanges. Most County residents travel to employment centers in other parts of the region, to developed areas adjacent to and within the City of Richmond (to the south) and the Town of Ashland. This out-commuting by Hanover County's residents burdens the transportation system and contributes to the roadway congestion during peak periods.

Population: As population in Hanover County grows, travel demand increases. In the last 13 years, population growth in Hanover County has outpaced growth in the Richmond-Petersburg Region. According to the United States Census Bureau, the population of the Richmond-Petersburg Metropolitan Statistical Area (MSA) increased by more than 15% between 1990 and 2000, from 865,640 to 996,512 persons, a difference of 130,872 people. During the same period, the population of Hanover County grew by more than 36%, from 63,306 to 86,320 persons.

With investment by the County in significant infrastructure, this growth is expected to continue. The long-range population forecast for Hanover County anticipates a population of 150,000 persons in 2022. The County's latest Comprehensive Plan (June 2003) builds on the past plan, and attempts to manage this growth into areas of the County deemed most appropriate, while protecting the character of the rural areas of the County.

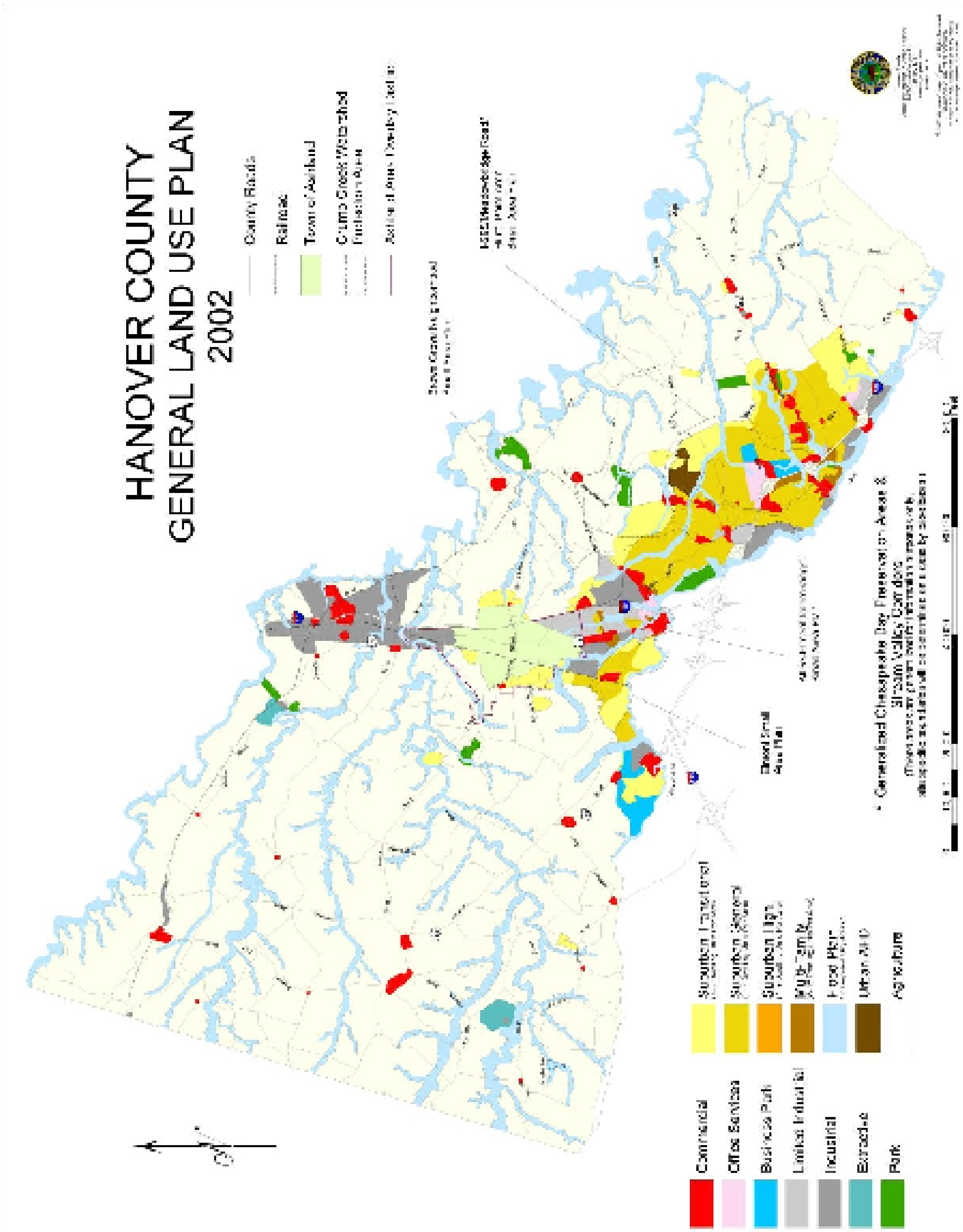
Employment: Employment trends, similar to population trends, influence the transportation system. According to the U.S. Bureau of Labor Statistics, between 1992 and 2002 total employment in the Richmond-Petersburg MSA increased more than 13% from 459,790 to 520,968 jobs, or by 61,178 jobs. With the influx of new jobs throughout the 1990s, the region's unemployment rate decreased from 6.7% in 1992 to a 10-year low of 1.9% at the end of 2000. Today, unemployment on a region wide basis is above 4% (2002).

In Hanover County, similar employment trends prevail. Between 1992 and 2002, total employment in the County grew 33%, from 36,740 to 48,870 jobs, an increase of more than 12,000 jobs. Following a similar unemployment rate trend, countywide unemployment rates decreased from 4.9% in 1992 to 2.8% in 2002, with a 10-year low in 2000 at 1.2%. Given the anticipated average annual growth rate of 2.5%, the number of jobs in 2025 can be expected to be over 88,000.

Economic Development: Hanover County promotes development in targeted Economic Development Zones (EDZ's) along the I-95 and I-295 corridors. These zones give priority consideration for development of infrastructure and fast-track permitting that will support new and expanding industrial and office projects. The anticipated traffic from these EDZ's has been a consideration in this study.

Land Use: According to the recently released 2022 General Land Use Plan of the County's Comprehensive Plan, growth along I-95 is slated to be primarily industrial, with limited industrial, and commercial land uses. Very little residential land use is planned. See **Figure 3-4**. Growth will be concentrated south of Route 54, along I-95 and I-295, with some industrial and commercial areas along the U.S. Route 1 corridor north of Ashland and along I-95 from Old Ridge Road to the Caroline County line. Traffic generated from these anticipated growth areas was considered in the development of traffic projections and the travel demand model used in this study.

Figure 3-4 – Hanover County 2022 General Land Use Plan



3.1.2 Town of Ashland

Ashland, Virginia also continues to grow, with its commercial and industrial centers concentrated along the Route 54 and U.S. Route 1 corridors. The Ashland interchange (Exit 92) is a popular stop for tourists and truckers alike, with dozens of national food chains and hotels located a short drive from the exit. The interchange is approximately halfway between Washington, DC and the North Carolina line, putting it at the center of the I-95 corridor in Virginia. This "Center of the Universe" as the Town calls itself, is home to a diverse collection of neighborhoods, businesses, and historic sites. When originally incorporated in 1858, Ashland consisted of one square mile. Founded as a railroad town, today, the Town has grown through annexations to 7.02 square miles, making it one of the larger towns in land area in Virginia.

Population: From 1990 to 2000, the Town grew at a rate of 12.9%, from 5,864 to 6,619 persons. According to the Town's 2002 Comprehensive Plan, Ashland is expected to experience moderate growth over the next 20 years, reaching a population of 11,390 by 2023.

Employment: In 1998, Ashland employed a total of 9,663 people—more people than it has residents. With many of its residents commuting to jobs in the Richmond area, peak period traffic contributes to the already significant volume of through traffic on the interstate.

Land Use: According the 2020 Comprehensive Plan, land use projections along the I-95 corridor and Route 54 include growth in planned residential development, general business, low-density residential, and light industrial. See **Figure 3-5**. Traffic generated from these land uses was taken into account in estimating future volumes for this study.

3.2 Transportation Modes and Activity Centers

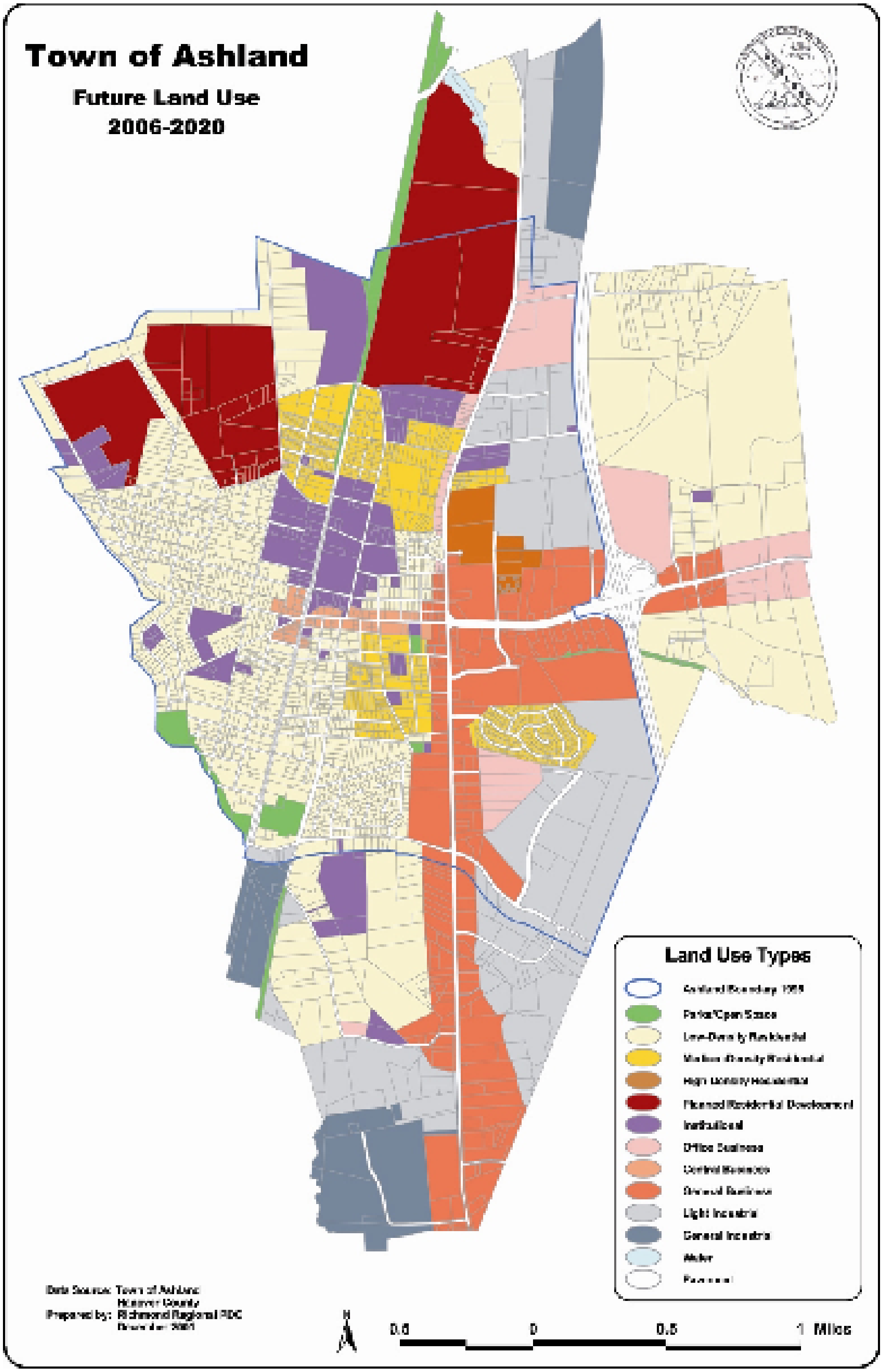
Along the I-95 corridor in Hanover County and Ashland, the dominant transportation mode is the open road. Vehicles travel on roadways between and within activity centers that include entire regions; individual towns, cities, and counties; and specific areas of development. Other modes of transportation do exist in this corridor, including local and regional bicycle routes (U.S. Bicycle Routes 1 and 76), bus service, and rail. The Amtrak station in downtown Ashland serves commuters traveling to Richmond and Washington, DC, as well as long-distance travelers. CSX provides the rail line, which is slated as the future high-speed corridor for the East Coast.

The prominent activity centers within the section of I-95 under study include the Town of Ashland, Kings Dominion, and existing pockets of development at the three study area interchanges. While these activity centers are important and affect the operations of U.S. 1 and I-95, one of the conclusions of this study is the following statement:

> *The regional orientation of I-95 in Hanover County is such that its operations are affected more heavily by interstate and inter-regional travel.*

Destinations along the "crescent" of Washington, DC, Richmond, and Hampton Roads make this section of I-95 a critical component to commerce in the Commonwealth of Virginia.

Figure 3-5 – Town of Ashland 2006-2020 Future Land Use Plan



Ridesharing and carpooling are being promoted along this corridor, although carpooling rates have declined in recent years, according to VDOT. In analyzing the data and looking at alternatives for capacity improvements, HOV lanes on I-95 were briefly considered. However, VDOT indicated that there are no planned HOV lanes south of the corridor with which to connect. An HOV lane study was done for I-64 in Richmond, and the recommendation was to not implement HOV lanes.

Park-and-ride lots are an option in this corridor. The Route 802 (Lewistown Road) and Route 54 (Ashland) interchanges are ideal candidate for park-and-ride lots.

3.3 Existing Conditions

Within the study area, the 6-lane section of I-95 mainline and the three existing interchanges with Route 802, Route 54, and Route 30 provide access to the activity centers in Hanover County and Ashland. These arterial roadways connect to other roadways in a network affected by travel demands from the continued growth in population and employment.

From field visits and a review of documentation, photography, and videotape (as well as the base mapping), observations were made of the existing roadways in the study area. In addition, an evaluation of existing geometric conditions was conducted in the corridor, including a review of the interstate mainline geometry and the geometry associated with each of the study area interchanges.

At the interchanges, existing taper lengths, deceleration lane lengths, acceleration lane lengths, weaving area lengths, and ramp curvatures were investigated and compared to current standards. In general, due to the type of interchanges at these locations (diamond or modified diamond), few *geometric* deficiencies exist, other than vertical and horizontal clearances for some bridges. In this study, the deficiencies along the mainline and at the interchanges have been found to be capacity-related or *operational*.

To establish a geometric and operational baseline for the corridor, a geometric inventory and operational analysis was completed for the I-95 mainline, as well as for the study area interchanges, arterials, and collector streets. **Figures 3-6, 3-7, and 3-8** indicate existing conditions in the vicinity of the study area interchanges.

3.3.1 I-95 Mainline

Throughout the study area, the 6-lane interstate mainline passes through low wooded hills, industrial and commercial areas, and agricultural land. The median along this length of I-95 ranges from a narrow grass or gravel strip with a barrier to separate traffic, to a significantly wide, wooded buffer. The photograph at right, as well as those shown in **Figures 3-1 through 3-3** show the mainline existing conditions.

Figure 3-6 – I-95/Route 802 (Lewistown Road) Interchange (Exit 89)

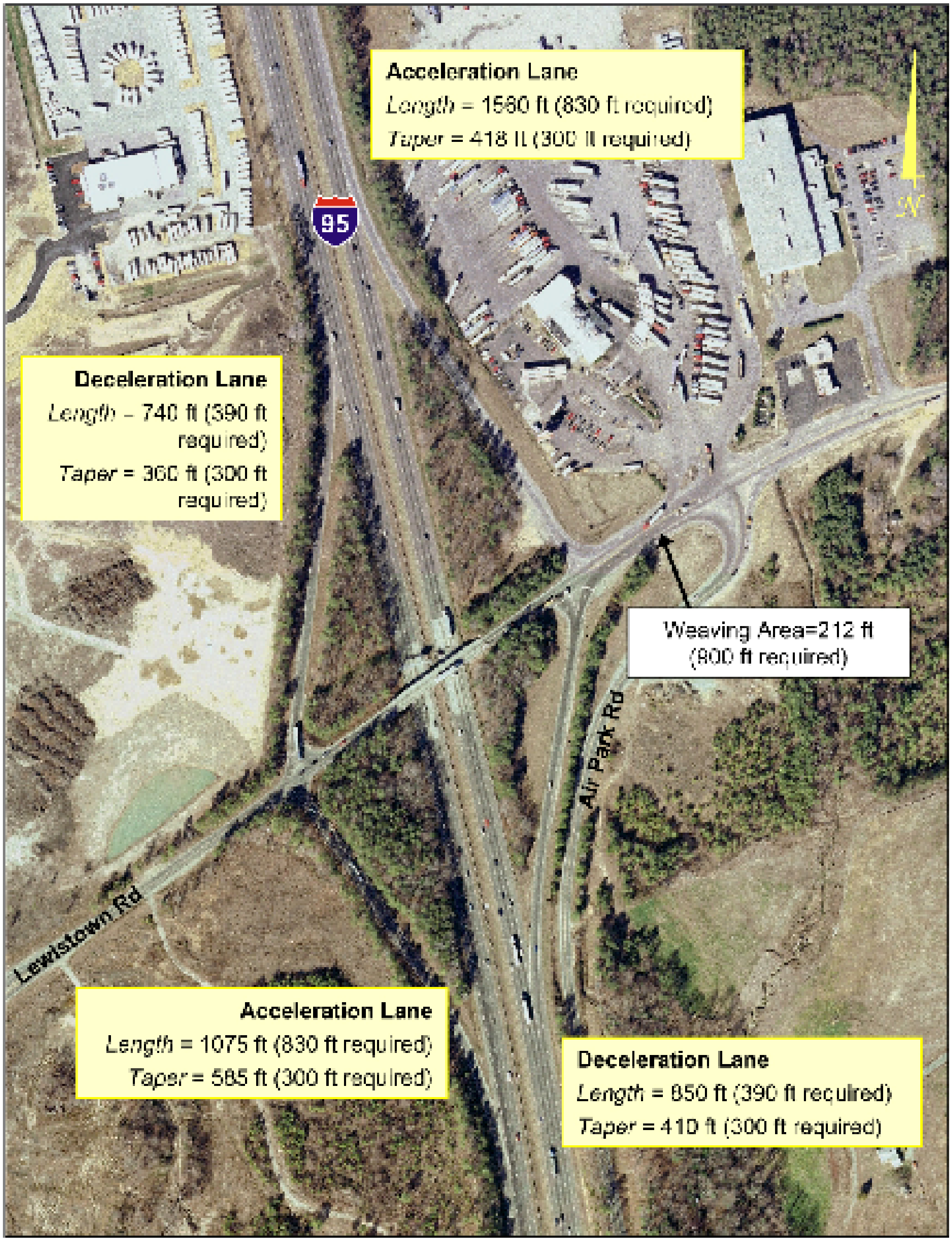


Figure 3-7 – I-95/Route 54 (Ashland) Interchange (Exit 92)

Figure 3-8 – I-95/Route 30 (Kings Dominion) Interchange (Exit 98)

The vertical alignment of the mainline is rolling, with some up and down grades as the highway crosses the South Anna, Pamunkey, and North Anna Rivers and the ridges in between. None of these vertical grades were observed to create significant operational issues on the interstate.

Similar to the vertical alignment, the horizontal alignment of the mainline does not appear to create or contribute to operational issues. Existing horizontal curves in the study corridor were found to meet or exceed 70 mph design standards specified by the American Association of State Highway Officials (AASHTO). While the posted speed limit is 65 mph, actual free-flow speeds were observed to range from 70 mph to 75 mph. Maximum speeds appeared to be above 85 mph.

Pavements and signage appeared to be adequately maintained. One-tenth mile markers do not exist on this stretch of I-95. They do exist from Caroline County to the Washington, DC metropolitan area. While these signs can aid in more quickly identifying the locations of incidents, given State Police and citizen reports, or the presence of an incident detection system, the signs represent a financial investment and can be a maintenance challenge. It is understood such signs may be considered by VDOT in the future.

A field reconnaissance of the cross sectional elements was conducted along the interstate mainline within the study area. Shoulder width deficiencies were noted throughout the corridor. These deficiencies included narrow inside shoulders in various locations along the corridor, especially in the vicinity of the existing interchanges. It has been noted by the TAC members that any capacity improvements to the mainline should include widening of the shoulders to meet current AASHTO requirements.

As shown in the photograph at left, vertical and horizontal clearance deficiencies were noted at the existing inter-change bridges and overpasses. Specifically, the Route 802 (Lewistown Road), Ashcake Road, and Route 54 bridges have vertical and horizontal clearances below standards. It should be noted that the latest asphalt overlay of the concrete pavement along the interstate was interrupted under these bridges to provide maximum possible clearance.

Some shoulder-related deficiencies can be addressed through minor shoulder widening and pavement overlays. In some locations, widening can be performed to the inside with the addition of a concrete median barrier. In other locations, the availability of right-of-way and slope/grade issues will result in the need for more substantial construction. In these locations, mainline lane shifts and median widening have the potential to provide the necessary space for increases in shoulder width. Bridge clearance issues will be more difficult and costly to address.

3.3.2 Route 802 (Lewistown Road) Interchange

Lewistown Road is a 2-lane undivided roadway and is indicated as a minor arterial (100-foot right-of-way) on the *Hanover County Major Thoroughfare Plan*. As shown in **Figure 3-6**, the

I-95/Route 802 interchange is a simple rural diamond design. The existing bridge over I-95 is the originally-built structure, accommodating only 2 lanes (and no shoulders) on Route 802. The northbound and southbound off-ramps are stop-controlled.

A truck stop, originally built in 1962, is located in the northeast quadrant of the I-95/Route 802 interchange (Exit 89). The other three quadrants are currently undeveloped, but industrial development is anticipated to occur west of the interstate. In the northwest quadrant, right-of-way has been reserved by Hanover County for a future interchange loop and ramp. According to the County Department of Public Works, *if these improvements are not constructed by the year 2020, this ROW preservation will expire that year*, and the land will revert to developable parcels.

The eastern end of Lewistown Road intersects with Ashcake Road, a 2-lane minor arterial traversing the central part of the County and the Town of Ashland. The western end of Lewistown Road intersects with U.S. 1, the historic long-distance travel route of the East Coast. Ashcake Road passes through a historically disadvantaged neighborhood, and planned roadway improvements have had to consider Environmental Justice issues. To the north of the I-95/Route 802 interchange, Ashcake Road crosses over the I-95 on a two-lane bridge.

As a part of the *Hanover County Major Thoroughfare Plan* and the New Ashcake Road Alignment Study, a new 4-lane, divided section of New Ashcake Road will be constructed parallel to the eastern Hanover County Airport property line. The new alignment will extend from the existing northern end of Sliding Hill Road to existing Ashcake Road. New Ashcake Road will intersect with Lewistown Road in a straight connection to provide a continuous movement. Air Park Road and the older Ashcake Road alignment will intersect with New Ashcake Road/Lewistown Road at a 4-way intersection.

The plan for this intersection is shown in the concepts drawings for the I-95/Route 802 interchange in Section 4 of this report. The existing Ashcake Road to the north of this intersection has been de-emphasized in the County's Major Thoroughfare Plan. Given future traffic volumes, Ashcake Road will remain a 2-lane roadway. Thus, there are currently no plans to widen the existing Ashcake Road bridge across I-95, but a new bridge would need to built to accommodate any I-95 widening.

U.S. 1 continues to serve as an important parallel route to I-95, despite having its utility reduced by urbanization along its length. In Hanover County and Ashland, U.S. 1 is a 4-lane undivided roadway with occasional turn lanes and speed limits of 45 to 55 mph. U.S. 1 serves as the closest diversion route for traffic on I-95, although such a diversion is not attractive to motorists unless an incident on the mainline stops traffic, or local services (i.e., gas, restaurants, shopping, etc.) are sought by travelers.

Referring to **Figure 3-6**, in the vicinity of I-95, general issues on Lewistown Road include:

- Narrow bridge (Lewistown Road) across I-95
- Lack of sight distance due to the vertical geometry of the bridge and side slopes along the ramps and Lewistown Road (guardrail close to intersection corners)
- Lack of sight distance due to the overgrowth of trees throughout the interchange, especially along the ramps and at the corners of their intersections with Lewistown Road

- Proximity of Air Park Road and the truck stop driveway to the I-95 northbound on- and off-ramps
- Proximity of the Lakeridge Parkway intersection to the I-95 southbound on- and off-ramps
- Vehicle queues related to left turning vehicles at the intersections of the I-95 ramps and Lewistown Road

In analyzing the existing geometric conditions at the interchange, the acceleration and deceleration lanes were found to meet minimal geometric standards. It is understood that these ramps were lengthened in the past 10 to 15 years to accommodate increases in traffic. At the interchange, the northbound and southbound ramps do not have exclusive right or left turn lanes.

The unsignalized Lewistown Road/Air Park Road intersection is located just over 200 feet east of the interchange, which makes the weaving area along Lewistown Road deficient with respect to geometric standards. At this intersection there are exclusive eastbound and westbound (Lewistown Road) left- and right-turn lanes and a northbound (Air Park Road) right-turn lane.

Currently planned future improvements include a coordinated signal system installed on Lewistown Road in the vicinity of the I-95 interchange. An initial plan proposed by Hanover County includes two new signalized intersections constructed at Lewistown Road/Lakeridge Parkway and Lewistown Road/Air Park Road/Truck Stop Driveway. A future phase (still prior to major capacity improvements) would include four signalized intersections in a coordinated system:

- Lewistown Road/Lakeridge Parkway (with turn lanes added to Lewistown Road)
- Lewistown Road/I-95 southbound ramp (with turn lanes added to Lewistown Road and to the ramp)
- Lewistown Road/I-95 northbound ramp (with turn lanes added to Lewistown Road and to the ramp)
- Lewistown Road/New Ashcake Road (with Ashcake Road and Air Park Road realigned to intersect together with Lewistown Road)

It should be noted that as of the date of this report, the concept for signalized intersections along Lewistown Road had not been approved by VDOT or FHWA. In addition, to optimize this 4-signal system, the Lewistown Road bridge should be replaced with a 4-lane bridge. However, an even wider bridge (6 lanes and a median) is recommended with the Preferred Concept for this interchange, as discussed in Section 4. Such a bridge would also need to be long enough to accommodate future widening of I-95.

3.3.3 Route 54 (England Street / Patrick Henry Street) Interchange

In the area of the interchange, Route 54 is a four-lane median-divided roadway known in Hanover County as Patrick Henry Road and in the Town of Ashland as England Street (east of downtown Ashland) and Thompson Street (west of Ashland). Route 54 has been called the gateway to western Hanover County, progressing west from the Hanover Courthouse area, through downtown Ashland (past the train station), and to the northwest, past Patrick Henry High School. Citizens in the County have advocated both for the widening of Patrick Henry Road and its preservation as a rural route.

In Ashland, Route 54 serves as Ashland's primary access to and from I-95. The majority of the development that has occurred along Route 54 in the vicinity of I-95 is located to the west. Land uses are primarily highway service related and include restaurants, hotels, gas stations, and a truck stop. In addition, a retail center has been approved by Ashland for development near the southwest quadrant of the interchange, including a Wal-Mart Supercenter store. As of the date of this report, construction had begun on this retail center, and initial phases were to be complete by the Fall of 2003.

As shown in **Figure 3-7**, the interchange is a rural diamond design with one loop in the northeast quadrant. Ramp intersections with Route 54 are unsignalized. The Route 54/Carter Road intersection just to the west of the interchange (accessing service stations and restaurants) sometimes creates backups onto I-95, even with left and right turn lanes for each direction of Route 54. With the approved development, this intersection is being moved approximately 400 feet to the west, to intersect with the new Hill Carter Parkway, which will access the Wal-Mart development to the south. In addition, Ashland's 2020 Plan includes widening of Route 54 from 4 to 6 lanes, from I-95 to U.S. Route 1. A future option also includes extending Hill Carter Parkway to the north.

Referring to **Figure 3-7**, general issues in the vicinity of the Route 54 (England Street)/I-95 interchange include:

- Need for a left turn storage bay for the westbound Route 54 to southbound I-95 movement
- Occasionally inadequate vehicle storage space on the I-95 southbound off-ramp for left and right turning vehicles
- Inadequate vehicle storage space along Route 54 for left turning vehicles during peak periods for the westbound to southbound movement
- Need for signal timing/coordination along Route 54
- Need for additional wayfinding signage on I-95
- Driveway frequency on Route 54
- Proximity of adjacent intersections to ramps
- Route 54/U.S. 1 intersection queues and delays

No geometric deficiencies were found at the I-95/Route 54 interchange, given current design standards. However, heavy vehicle volumes, nearby traffic signals, and general issues associated with interchanges having loop ramps invite potential operational issues at this location.

The unsignalized intersection with Route 54 (England Street) and the northbound ramp to I-95 has an exclusive eastbound left-turn lane and an exclusive westbound right-turn lane. Westbound Route 54 has been reconfigured to allow the I-95 northbound loop off-ramp to free flow onto westbound Route 54. To allow the northbound I-95 exit ramp to free-flow onto eastbound Route 54, a short acceleration lane is provided on Route 54.

The unsignalized intersection with Route 54 and the southbound ramp to I-95 has an east-bound (Route 54) free-flow right-turn lane to the southbound I-95 on-ramp. The westbound (Route 54) to southbound movement does not have a left-turn lane, but one could be installed as an interim measure. Traffic exiting from I-95 southbound has a free-flow right turn to westbound Route 54 and a short storage bay for left turning vehicles. Occasionally traffic turning right or left is impeded and causes backups onto I-95.

3.3.4 I-95 Overpasses

In addition to the Ashcake Road overpass south of the I-95/Route 54 interchange, three local roadways pass over I-95 between the Route 54 interchange and the Route 30 interchange, six miles north.

- **Jamestown Road** (Route 698), within the limits of the Town of Ashland, is a 2-lane roadway, crossing over I-95 with a 2-lane bridge. In the future, Ashland plans to connect Woodside Drive east of the Route 54 interchange to Jamestown Road to create a northeast corridor within the town limits.

- **Hickory Hill Road** (Route 646) is a two-lane roadway shown on the *Hanover County Major Thoroughfare Plan* as a major collector. Currently, Hickory Hill Road crosses over I-95 on a 2-lane bridge. According to the recently-released 2022 Hanover County Comprehensive Plan, the planned land uses in the vicinity of I-95 along Hickory Hill Road are rural and agricultural. Concepts for a future Hickory Hill Road range from maintaining its rural character to providing improved access to and from the Hanover Courthouse area, the I-95 corridor, and northwest Hanover County.

- **Old Ridge Road** (Route 738) is a two lane rural road crossing over I-95 on a 2-lane bridge and crossing underneath the CSX rail line through a narrow one-lane culvert. Old Ridge Road connects Hickory Hill Road and the northwest part of Hanover County. Land uses include a combination of agricultural and industrial zoning along this route.

3.3.5 I-95 / Route 30 (Kings Dominion / Doswell) Interchange

The Route 30 interchange was originally a simple rural diamond design dating to the early 1960's. Evidence of the old ramps can be seen in **Figure 3-8** west of the interchange. In the mid 1970's, Kings Dominion funded the modification of the interchange to increase its capacity to accommodate traffic entering and exiting the new theme park. As shown in the figure, these changes included:

- Southbound directional flyover ramp (under Route 30 and over I-95) that serves traffic exiting from southbound I-95, as well as traffic exiting the park and accessing Route 30 southbound I-95
- Addition of two loop ramps to southbound I-95: one from westbound Route 30 and one from the park exit to the directional flyover bridge
- Northbound exit ramp from I-95 widening to two lanes

- Widening of Route 30 to accommodate 2 lanes into the theme park from the northbound I-95 exit ramp

Route 30 is a two-lane undivided roadway from the interchange ramps to U.S. 1. Through the interchange and along the front of the Kings Dominion theme park, this route is a four-lane divided roadway, transitioning back to two lanes beyond the railroad tracks east of the park entrance. The entire length of Route 30 in Hanover County is shown as a major arterial (with right-of-way width of 120 feet) on the *2022 Hanover County Major Thoroughfare Plan*.

In the vicinity of I-95, Route 30 has been widened to four lanes to help accommodate traffic associated with the Kings Dominion theme park, located in the southeast quadrant of the interchange. Land uses in the vicinity of the interchange include Kings Dominion (southeast quadrant), a motel (southeast quadrant), restaurants (northeast quadrant), and a truck stop (northeast quadrant). In addition, there are other truck-related destinations that are served by the interchange including the BFI landfill to the east of Hanover County, a timber/lumber mill to the east in West Point, and the Martin-Marietta quarry northwest of Doswell, a crossroads along U.S. 1, north of the U.S. 1/Route 30 intersection.

Referring to **Figure 3-8**, general issues in the vicinity of the I-95/Route 30 interchange include:

- Queues/delays related to parking fee collection at Kings Dominion
- Lack of wayfinding signage to better inform drivers of destinations along Route 30
- Wayfinding/signage deficiencies related to Kings Dominion entrances and exits
- Sight distance constraints due to trees/vegetation on northbound and southbound entrance ramps, and due to vertical curve in Route 30 bridge over railroad tracks west of the interchange
- Congestion/delays along U.S. 1 related to Kings Dominion traffic diversions

Deficiencies at this interchange relate to ramp curvature and include the following locations where the existing configuration provides for design speeds of 30 mph or less:

- Northwest quadrant loop ramp
- Southwest quadrant loop ramp
- Northbound exit ramp from I-95—curve radius from the ramp to Route 30
- Northbound entrance ramp to I-95—curve radius from Route 30 to the ramp

A signalized intersection that serves the Kings Dominion service road and the truck stop is located approximately 1,000 feet east of the interchange. There are exclusive eastbound and westbound left-turn lanes on Route 30 at this intersection. A major operational drawback to this signal is that it often interrupts the free flow of traffic from northbound I-95 into the theme park. This interruption sometimes ripples back to the interstate mainline where traffic can come to a stop. More optimized signal timing could better accommodate the heavy influx of vehicles to Kings Dominion.

3.4 Stakeholder Feedback

Work on the I-95 Corridor Study involved a number of organizations, or "stakeholders," that have mutual and varied interests in the outcome of the study. The TAC members agreed that the study would benefit from one-on-one discussions with a number of these stakeholders. Thus, the interviews were conducted to meet the following objectives:

- To gain insight on a range of specific issues that may influence the study.
- To gather pertinent information that was otherwise not readily available through our review of documentation and existing data.
- To establish communications between the stakeholders and the consultant team for continued coordination throughout the study.

3.4.1 Stakeholder Interviews

The stakeholders to be interviewed represented those organizations that have a vested interest in the study. To make the most efficient use of the efforts of this task, the public at large and small and large businesses were represented by various departments of their respective government organizations, as well as Industrial Development Authorities (of the County and the Town). The TAC agreed that the one business entity that should be interviewed directly was the Kings Dominion theme park, the only business in the study corridor with its own access ramp to and from I-95.

Thus, the stakeholders interviewed for this I-95 Corridor Study included representatives from the following organizations:

- Members of the study's Technical Advisory Committee (TAC):
  - VDOT Transportation and Mobility Planning Division
  - VDOT Richmond District Traffic Engineering
  - VDOT Richmond District Location and Design
  - VDOT Ashland Residency
  - FHWA Virginia Division
- Hanover County Departments: Administration, Economic Development, Planning, and Public Works
- Town of Ashland Department of Public Works
- Richmond Regional Planning District Commission (RRPDC)
- Hanover County Sheriff's Department
- Town of Ashland Police
- Virginia State Police
- VDOT Managers of the Virginia Maintenance Services (VMS) Contract
- Kings Dominion

Along with regular meetings with the study's Technical Advisory Committee (TAC), and continuous discussions with VDOT's project manager from TMPD, these stakeholder interviews were a key component in obtaining the insights needed to complete this study.

3.4.2 Stakeholder Comments

Highlights of input from the stakeholders are listed below:

I-95 Mainline

- Traffic is "monstrous," "awful." Lots of backups in both directions, any time of the day, any day of the week.
- Major diversions of traffic off of I-95 along U.S. 1 happen about 2-3 times per year.
- In summer, traffic is heavy all the way around. Race weekends are heaviest.
- If you took the access points (interchanges) off the corridor, traffic volumes would still be huge. Corridor is rural, but traffic on mainline not indicative of surrounding land use.
- Truck traffic is heavy – 3 truck stops in this corridor, one at each interchange.
- There is no good way to flush traffic off mainline and through the corridor. U.S. 1 and U.S. 301 are parallel routes, but not great choices.
- Shoulder rumble strips have been a good added safety measure.
- Bridges hit by over height vehicles, equipment on flatbeds, boats. Lewistown Road bridge hit two years ago. Route 54 bridge hit last year.
- Tourism in Ashland and County continues to be strong—expected to increase in demand.
- This section of I-95 does not have VSP Motorist Assistance, nor VDOT Safety Service Patrol. Both of those extend from Richmond to just I-295.
- Civil War battlefield map overlays indicate that improvements to the existing interchange would not have an adverse impact on such sites.

Route 802 / Lewistown Road Interchange Area

- Lewistown Road interchange is a "powder keg"—traffic will suddenly back up there.
- Add storage to ramps as near-term fix—widen to two or more lanes, lengthen.
- Long-term fix should be a cloverleaf or similar concept.
- Hanover County IDA: Priority for corridor is near- and long-term solutions at this interchange.
- The area surrounding this interchange is one of the County's current economic development zones.
- The left turns from the off ramps to Lewistown Road are tough for trucks. A tractor-trailer recently overturned on the southbound off-ramp.

Route 54 Interchange Area

- Backups sometimes occur on mainline, especially southbound traffic, which is affected by signal on Route 54.
- Great development pressures exist at Route 54, and these will increase with development inside town limits and in the county east of the interchange.

- Connection of arterials/minor collectors around town could form a loop through town to alleviate traffic on Route 54.
- Future Hill Carter Road intersection (replacing current intersection) will improve situation of existing intersection just west of Route 54 interchange.
- Wal-Mart development will only add stress to this interchange and to Route 54.
- Need left-turn lane for westbound Route 54 turning south onto I-95 ramp.
- Hanover County will have additional residential development coming on-line to the east of the interchange (further burdening the westbound-to-southbound movement).

Route 30 Interchange Area

- Route 30 (Kings Dominion) traffic backs up onto the mainline, especially on weekends.
- Kings Dominion owned the bridge until just 3 years ago (now owned by VDOT).
- Destinations for trucks using Route 30 interchange (traffic generators):
  - BFI landfills in King and Queen and King William counties
  - Timber/lumber mill in West Point east of interchange
  - Martin-Marietta quarry northwest of interchange, northwest of Doswell RR yard
- Parcels in the NE quadrant of interchange planned for industrial use.
- The traffic signal on Route 30 eastbound before the entrance to Kings Dominion often impedes flow. KD needs a free flow right into the park (avoiding the intersection to the truck stop and Best Western motel).
- At the Route 30 interchange, a typical accident on I-95 is running off the shoulder.
- Water table is high in the KD area. Underdrains would be needed for improvements. Would need a lot of good fill.

Kings Dominion (KD)

- In top 10 taxpayers/employers in county.
- The park capacity is 45,000 – 48,000 people, no more.
- Max preferred attendance 28,000 to 30,000, the level before attendees start to feel the park is crowded, where lines form, where complaints come from patrons.
- Split of traffic into KD used to be 65% from north, 35% from south (15 years ago). Now the split is more like 55% from the north. Projected to be 50-50 in 20 years.
- More season passes selling, resulting in less of a peak at opening and closing.
- Route 30 traffic has grown—becoming an impact to KD.
- Constant conflict with left turns on Route 30, especially traffic leaving KD in the evening.
- Deputies/State Police often work the traffic, reprogram traffic signals to flush traffic from KD. VDOT has been very receptive to this active traffic management.
- KD has seen lots of accidents at this interchange, especially southbound with the two merging lanes.
- Gates: 1,000 – 1,200 vehicles per hour, 6 gate lanes.
- KD needs to fix internal circulation. Guests can enter the parking lot fairly easily, but getting out is extremely difficult.
- KD parking: 8,500 vehicle spaces and with 3,000 overflow spaces, 150 bus spaces.

- Vehicle occupancy is 3 to 3-1/2 people per vehicle.
- Traffic congestion on I-95 is potentially impacting business. Traffic is often at a standstill.
- Need VMS signage on the interstate.
- On certain days of the year there are events at Kings Dominion that require VSP to shut down the northbound right lane and make it the exit lane for KD. Backups from Kings Dominion sometime reach as far as the Lewistown interchange.

Hanover County

- The 1972 Land Use Plan included a crescent of continuous development from southeast to the north, along I-295 and I-95. The plan was rolled back in subsequent updates to control growth in the county.
- The large development potential in Hanover County is recognized.
- Need to both control growth and provide infrastructure.
- Tourism is a big draw.
- Economic development zones are consistent with land-use plans.
- Expecting 100,000 SF of commercial construction in near term.
- Growth is occurring now at 25,000-50,000 SF per site. Examples: Short Pump, Stony Point, Virginia Center … limited industrial 217 acres.
- I-95 could be termed an industrial corridor.

Town of Ashland

- There are development pressures in the NE and SE quadrant of the Route 54/I-95 interchange.
- Ashland land-use plan converting some industrial areas to residential/mixed use.
- Industrial corridor exists in Hanover County, outside the town limits.
- The preferred location of a bypass is to the southwest, perhaps connecting the existing corridors (which serve commuters today).
- A bypass to the north of town is still possible, one that would connect Hill Carter Road with local streets.
- Businesses like the Cracker Barrel do provide a good tax base for the Town, as well as jobs.
- The Town has 10,000 jobs but only a population of 6,600.
- This I-95 study will complement the updates to the Town of Ashland Comprehensive Plan/Land Use Plan.
- Town is attempting to apply for Main Street affiliate status.

Caroline County

- Exits 104 and 110 are diversion points to access Routes 1 and 301 for avoiding backups on I-95.
- Developments are currently being planned in the vicinity of the Route 207 interchange at Carmel Church (Exit 104) and in the vicinity of the Route 639 interchange near Ladysmith (Exit 110) (Ladysmith Village Center).

ITS (Intelligent Transportation System) Considerations

- The current ITS components (i.e., variable message signs, closed-circuit TV cameras, etc.) are focused on the southbound direction along this corridor, i.e., the inbound traffic for the Richmond Metro area.
- Northbound traffic is not a current focus of the Richmond District, but could be in the future.
- The closest closed-circuit television (CCTV) cameras are at Exits 84 and 86.
- Highway Advisory Radio (HAR) is available along the corridor, with a station at the Route 54 interchange transmitting on AM 1620. The range of this signal is 4 miles.
- There are 2 variable message signs (VMS's) within this 12-mile corridor: MM 100 NB, 94 SB.
- For I-95 southbound, a VMS is located at mile post 93. A CCTV camera is planned for this location.
- Portable VMS's would help during heavy traffic.
- Lifting commercial restrictions (i.e., no trucks in the far left lane) could be a response to moving traffic around incidents or backups to Kings Dominion.
- Safety Service Patrol (VDOT ITS function) does not exist for this section of I-95.
- State Police Motorist Assistance exists on I-95 in Richmond only up to mile marker 84. There is no Motorist Assistance for this section of I-95.

Long-Term Considerations

- Interchange concepts need to facilitate flow, provide good access, with full consideration of access management.
- Don't "under-build" interchange concepts.
- Solutions should also be designed for maintenance, as well as operations.
- Include noise abatement/sound walls with interchange/mainline improvements.
- If cloverleaf interchanges are a solution, need collector-distributor (C-D) roads.
- ITS applications should be built into future projects.
- Fix substandard geometric conditions:
  - Widths of left and right shoulders
  - Lengths of ramps, tapers, weave areas
  - Horizontal and vertical clearances
- Air quality will be a constraint to actually adding lanes/adding capacity to the interchanges, but this study is not constrained by air quality issues.

The stakeholder interviews conducted during the I-95 Corridor Study have been a key component in obtaining the insights needed to perform the analysis for this study. The input has helped the study team draw conclusions about needed improvements, and it has helped in developing concepts for improving traffic operations in the study area.

3.5 Travel Demand and Traffic Forecasts

As Hanover County and the Town of Ashland continue to experience growth, travel demand will increase throughout the study area. To accommodate these increases, transportation system improvements will need to be planned, funded, and implemented. The focus of this I-95 Corridor Study has been to determine a set of logical transportation improvements to meet the demands of future year traffic. This section discusses the development of current year (2002) traffic volumes and the forecasting of future year (2025) traffic volumes for segments within the corridor. These volumes were subsequently used in analyzing operations in the corridor and in developing the concept improvements.

3.5.1 Current Year (2002) Traffic Volumes

As discussed in Section 2, traffic volumes were collected from several sources, including existing VDOT counts, the MINUTP model, and counts conducted by Kimley-Horn and O.R. George & Associates. This traffic data was analyzed, and average annual daily traffic (AADT), AM peak, and PM peak volumes for each of the major roadway segments within the I-95 corridor were derived for current year and future year conditions as discussed below.

The first step in deriving AADT volumes for each segment of the corridor was to use the traffic counts as controls for examining existing traffic volumes. These counts included those conducted with this study, 2002 counts from VDOT's I-95 count station, factored 2001 VDOT counts, and count data from recent traffic studies. Tube counts conducted for this study were adjusted for trucks (axles) for a true vehicle count. In addition, the current MINUTP model was used as a guide in identifying current year traffic. The initial set of AADT's was reviewed and balanced within the overall study area. The result of this effort was a set of 2002 existing AADT volumes for the I-95 corridor. These volumes are shown in **Figure 3-9**.

To derive peak period volumes, the study relied on turning movement counts (TMC's) conducted in August and November 2002, as well as a comparison to recent studies. TMC data was plotted on the study area intersections, and minor adjustments were made to balance the traffic on roadway segments within the study area. The result of this effort was a set of 2002 AM and PM peak hour traffic volumes. See **Figures 3-10 and 3-11**.

3.5.2 2002 Mainline Volumes and Travel Patterns

Supplementing the current year traffic volumes was information from the permanent VDOT 24-hour count station located at the southern end of the study area, between Route 802 and Route 656 (Sliding Hill Road). From the permanent count station, 7-day data sets were compiled for periods in May, August, and September-October 2002.

From these counts, the following observations were made:

- Seasonally, traffic is heaviest during the summer, specifically in August, when school starts in some areas while other areas are on summer vacation and Kings Dominion is in operation. The combination of vacation, school-related, work-related, and other travelers results in the heaviest volumes of the year on I-95, approximately 156,000vehicles per day (on a Friday). The weekly traffic trends are illustrated in **Figure 3-12**. As travel is spread throughout the week, the heaviest traffic periods occur on Friday, Saturday, and Sunday.

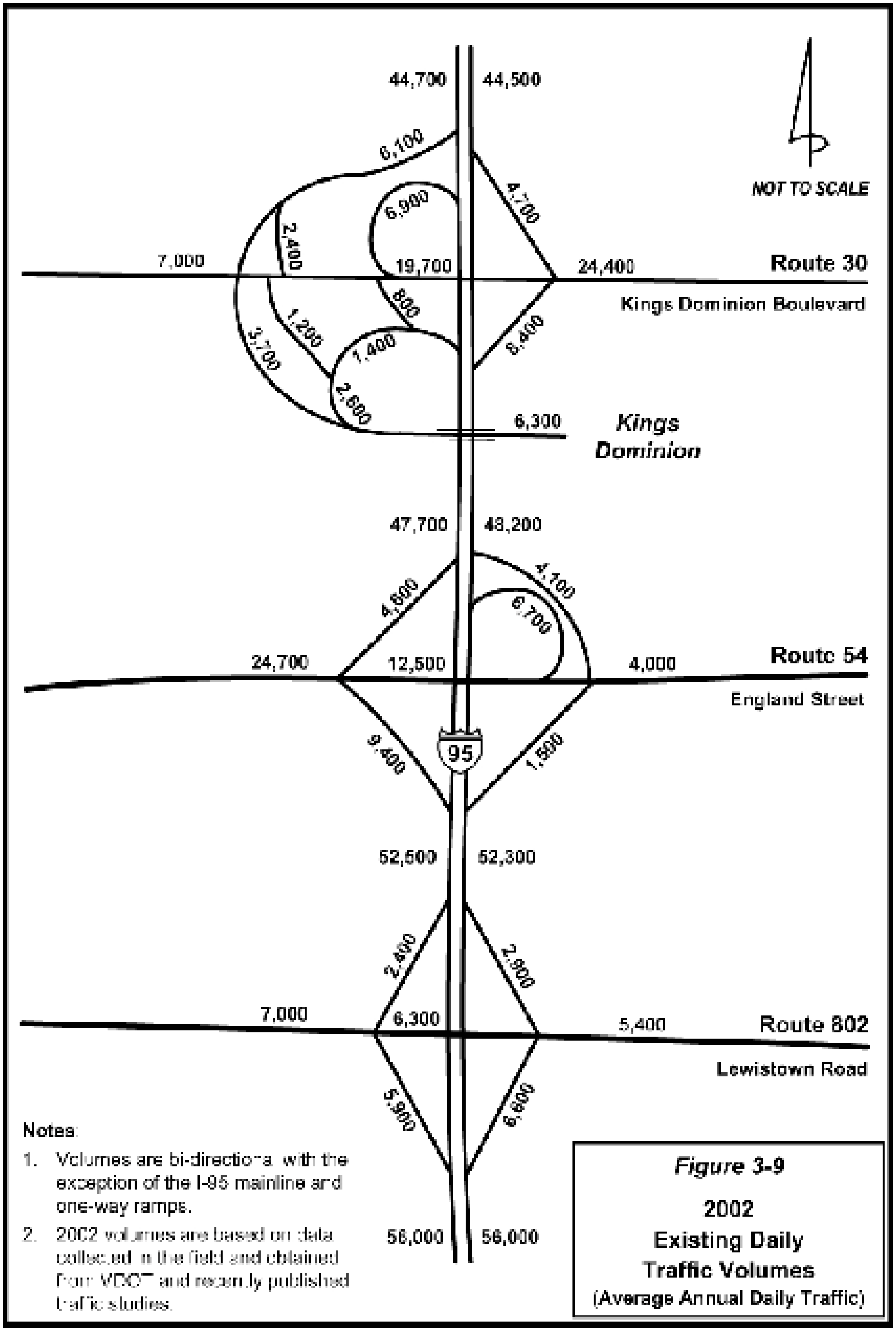


Figure 3-9

2002 Existing Daily Traffic Volumes

(Average Annual Daily Traffic)

Notes:

1. Volumes are bi-directional with the exception of the I-95 mainline and one-way ramps.
2. 2002 volumes are based on data collected in the field and obtained from VDOT and recently published traffic studies.

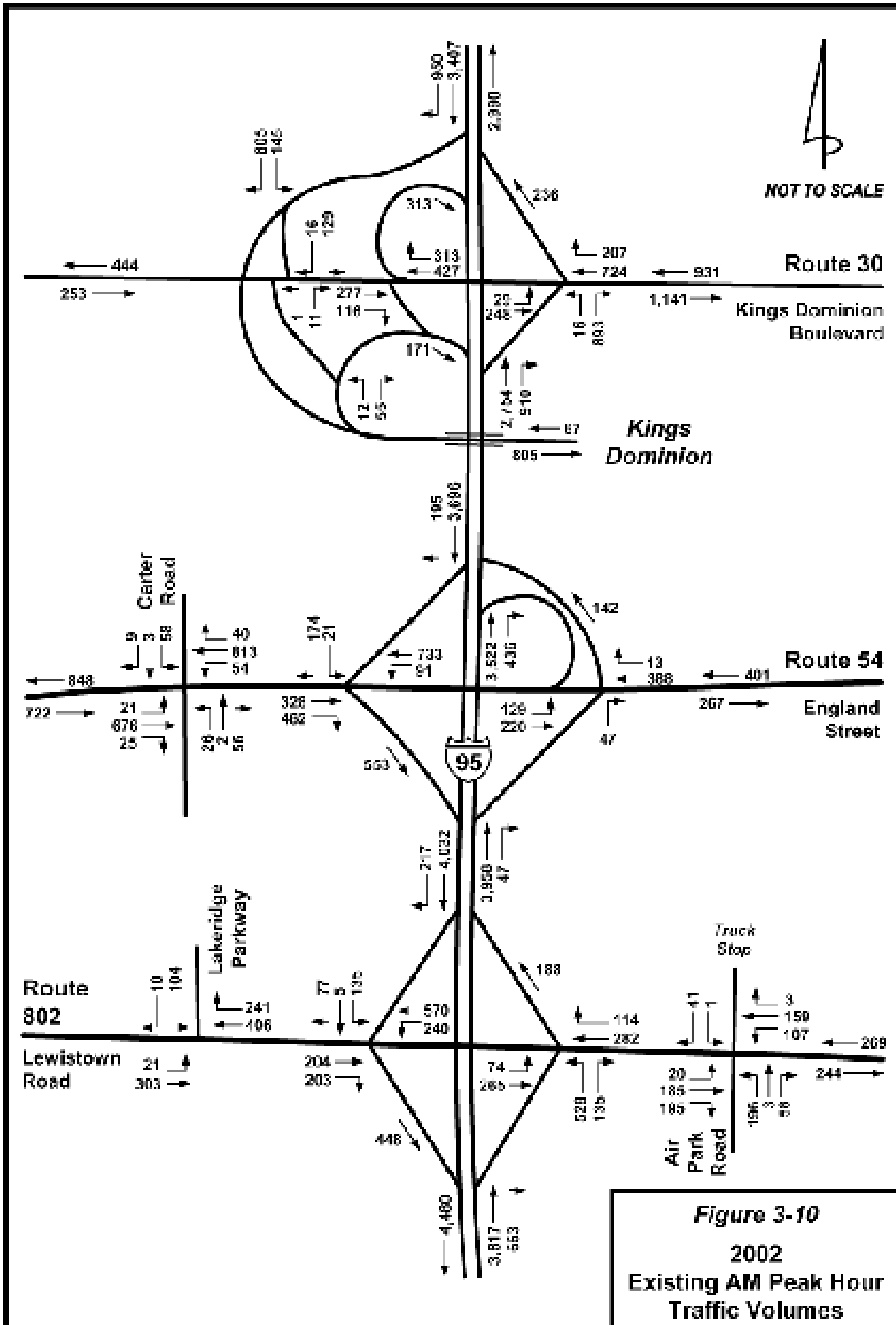


Figure 3-10

2002 Existing AM Peak Hour Traffic Volumes

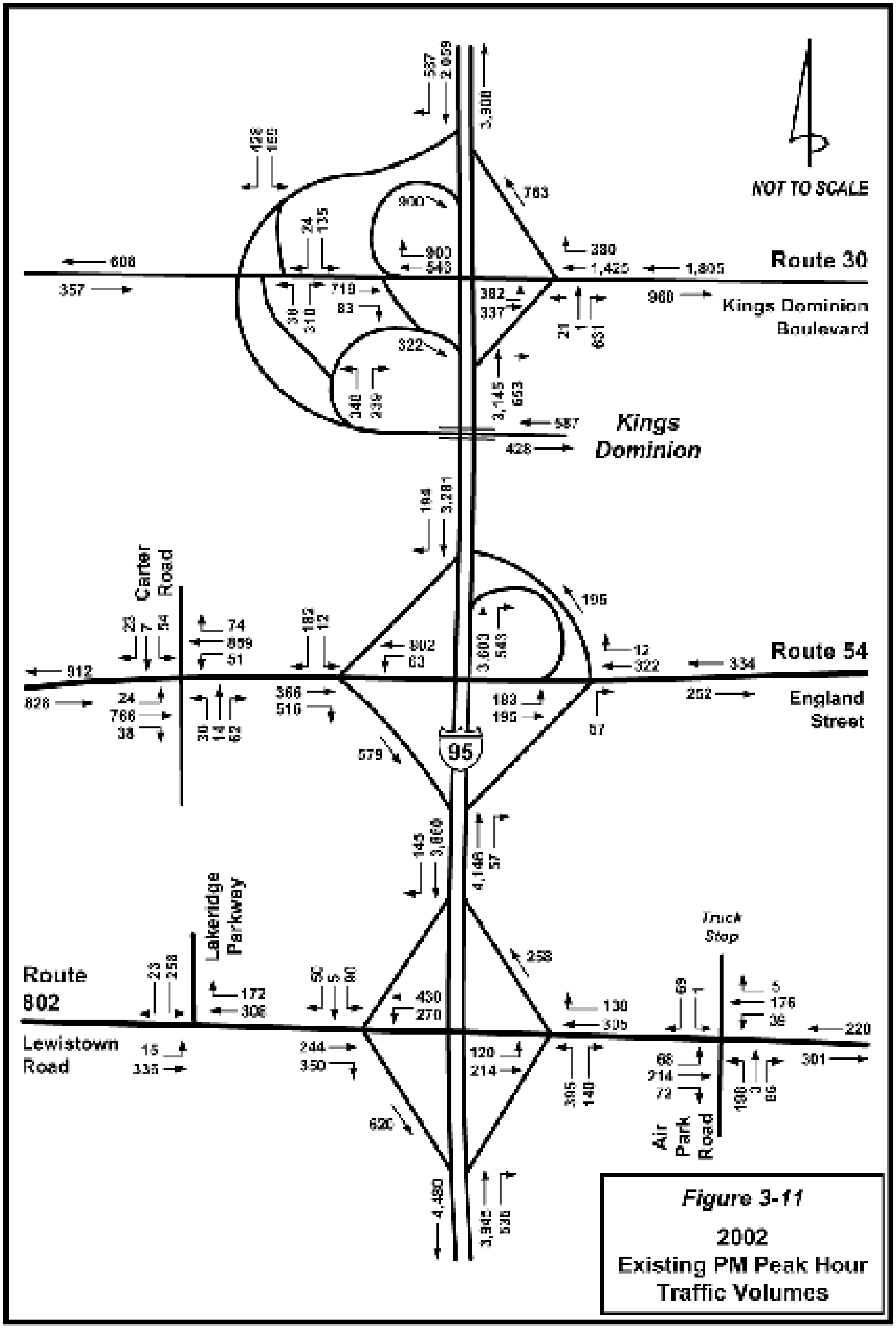


Figure 3-11
2002
Existing PM Peak Hour Traffic Volumes

- Many typical roadway facilities experience congestion and heavy traffic volumes for short durations, typically during weekday commuting hours, and typically from 7 am to 9 am and from 4 pm to 6pm. I-95 is busy during these periods—and it is also busy during 10 other hours of the day. Collected traffic counts revealed that traffic volumes build throughout the day, beginning at approximately 7 am and reach a daily peak between 5 and 6 pm. The off-peak period starts at approximately 10:00 pm. **Figure 3-13** illustrates this trend.

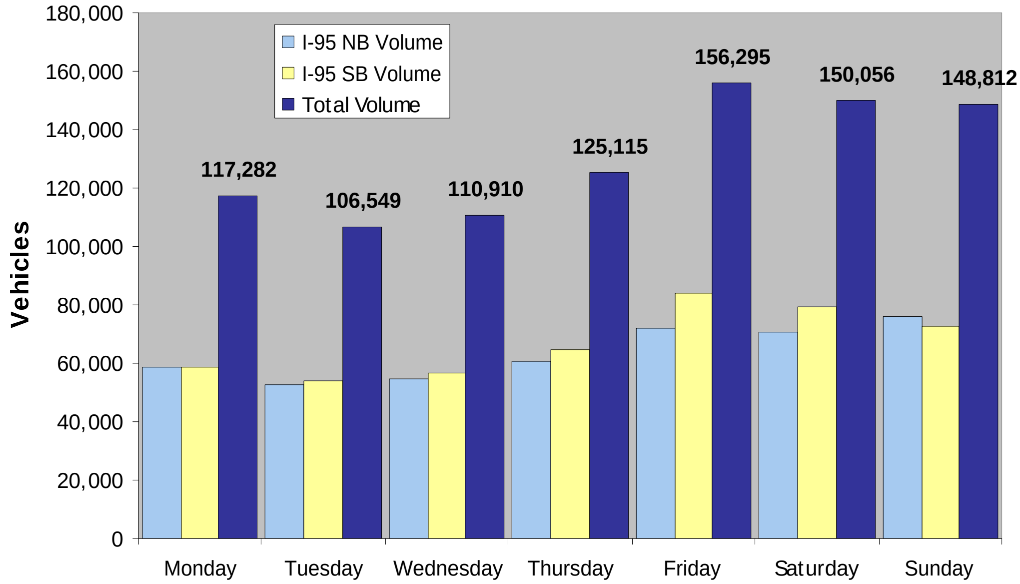


Figure 3-12—Summer 2002 Volumes

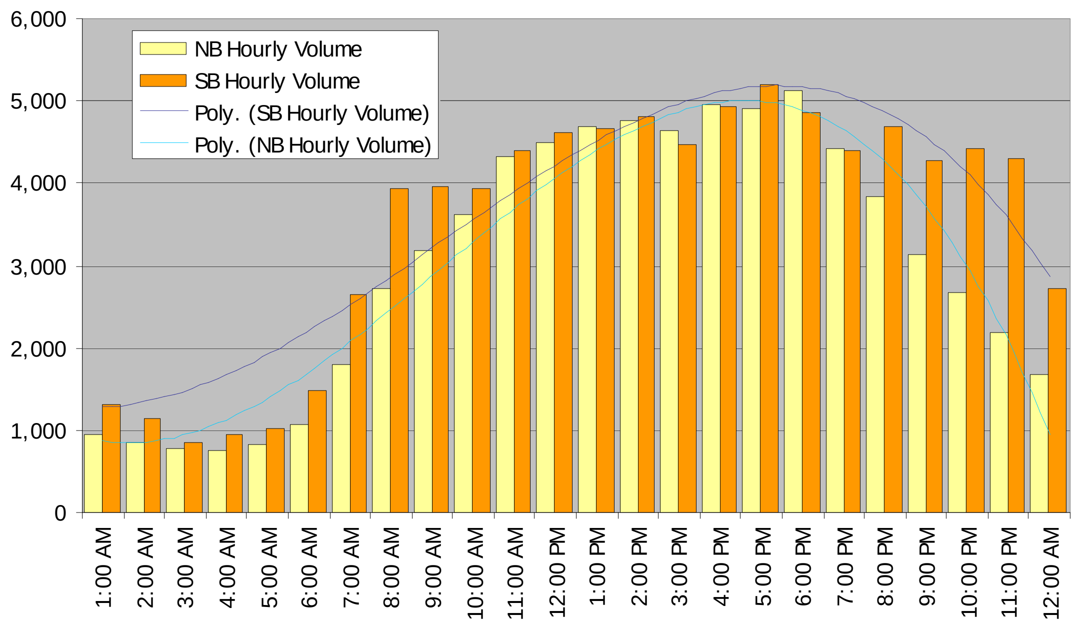


Figure 3-13—Hourly Traffic Volume Trends

- I-95 not only carries high volumes of traffic, but the interstate also supports a high volume of heavy vehicles. On average, a traffic stream on a typical thoroughfare or collector street is composed of approximately 2% heavy vehicles. In contrast, the percentage of heavy vehicles using I-95 was observed to peak at approximately 20%. **Figure 3-14** illustrates observed daily heavy vehicle usage of I-95.

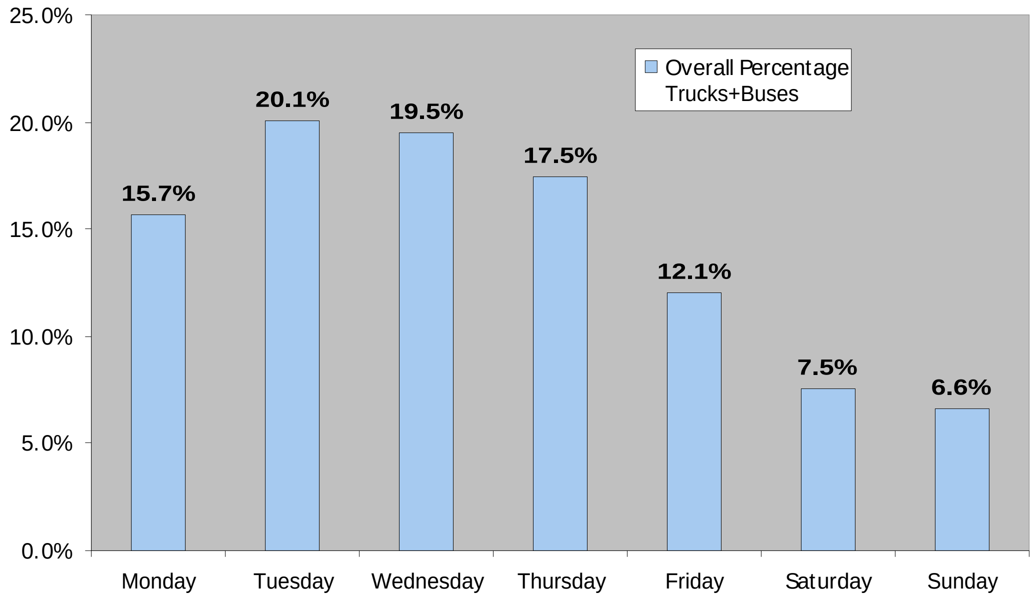


Figure 3-14 — Percent Heavy Vehicles

3.5.3 Future Year (2025) Traffic Volumes

To analyze future year conditions in the I-95 corridor, travel demand at study area intersections and on study area roadways was projected for the year 2025. The recommended concepts in this study were tailored to meet the demands of these forecasts.

Future traffic growth assumes that current the pattern of trip making continues, influenced by local (study area), regional, and state increases in population and employment. The Richmond Regional Travel Demand Model is the primary means for forecasting and evaluating long-range future travel demand in the Richmond region. The model relies on 1998 era assumptions on population, employment, and transportation system forecasts for 2023 to project future travel demand. While the model is not precise, especially when looking at smaller areas in the region, it is a good tool for estimating future travel demand.

For this study, it was necessary to first investigate the model's output and then compare that output with knowledge gained in 2002-2003 from recent studies and from the stakeholders of this study about projected future year conditions. In the time since the socio-economic and transportation network forecasts were prepared for the Richmond Regional Model (1998), some future growth and transportation network assumptions have changed. These new assumptions added traffic to the model's projections for the future. Thus, to better understand the impact of these assumptions, two sets of future year traffic volumes were prepared: (1) 2025 Baseline (Model) Volumes and (2) 2025 Projected (Study) Volumes.

3.5.4 2025 Baseline (Model) Volumes

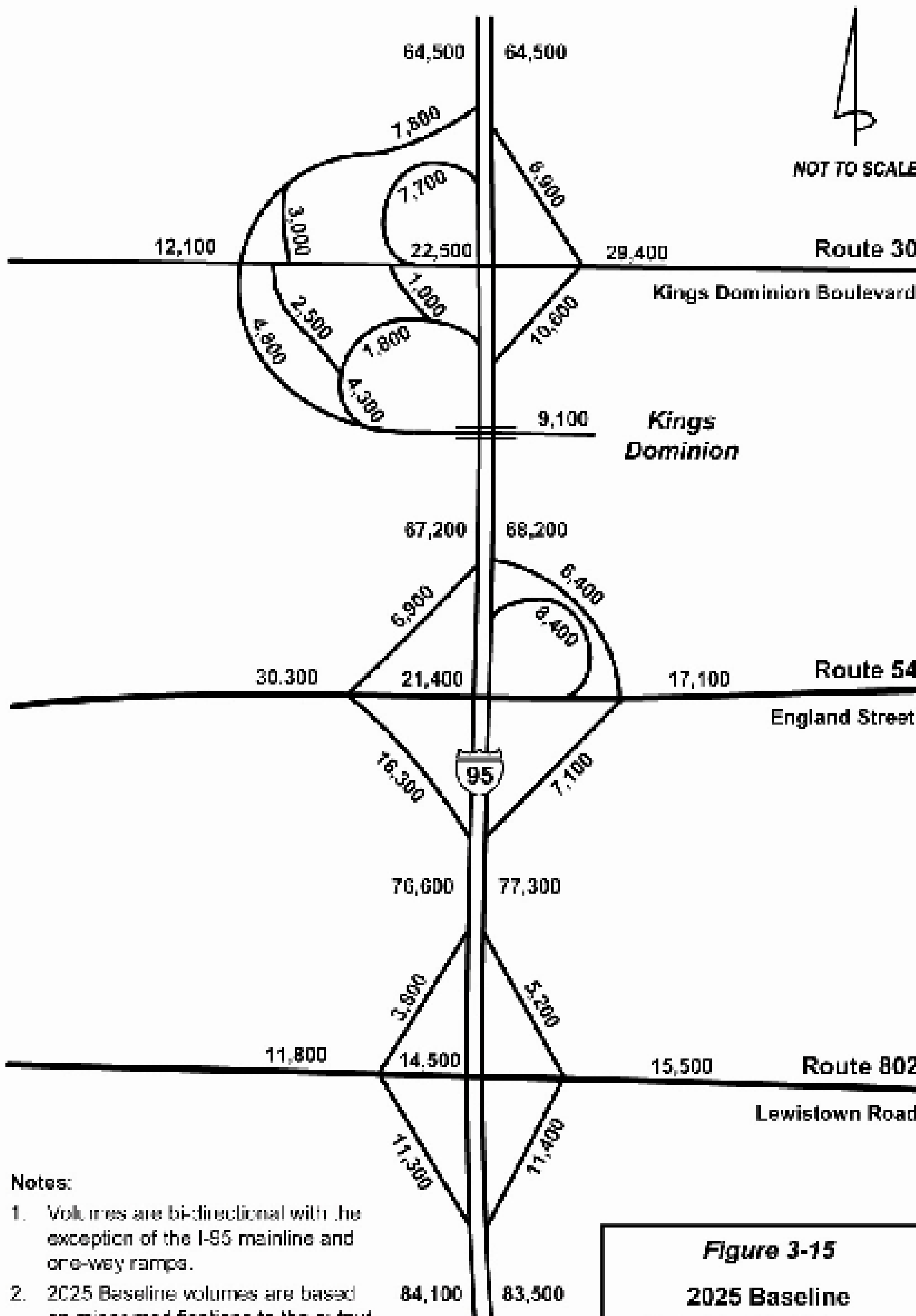
Using socio-economic data assumptions included in the current (1998) regional model, and making minor modifications to the transportation network to balance the volumes in the study area, estimates of traffic volumes were prepared for 2025. Since the regional model's horizon year is 2023, all projections were increased by a fixed growth rate computed by comparing existing traffic volumes to 2023 traffic volumes.

In addition to increasing volumes to reflect 2025 traffic levels, minor alterations were made to the network to better reflect centroid loading conditions and traffic distribution on major roadways. These modifications resulted in a slight re-distribution of traffic in the study area network to better reflect anticipated future roadway conditions. The modifications to the baseline model network are summarized as follows:

- Centroid connectors were modified to better reflect actual and anticipated loading conditions.
- The I-95 north external station was updated to reflect more realistic long-term annual growth at a rate of 1.5% to 1.7%, or 89,000 vehicles per day (vpd) in 2002 to 132,000 vpd in 2025.
- U.S. 1 capacity was updated to better reflect actual corridor capacity (urban/suburban 4-lane arterial) and the existing traffic volume relationship between I-95 and U.S. 1.
- Interchange volumes were increased to reflect growth rates of 1% per year at Kings Dominion Boulevard (excludes Kings Dominion park traffic), 1.5% per year at Route 54, and 2% per year at Lewistown Road.
- Peak hour ramp volumes were created by increasing existing volumes in accordance with future daily growth increases (i.e., if daily volumes increased by a factor of 2 in the future, existing AM and PM peak hour turning movement volumes were increased by a factor of 2 to reflect 2025 conditions).
- AM and PM peak hour volumes on the I-95 mainline were created by using 7% of the daily volume at the southern end of the study area. Volumes for other parts of the corridor were developed by balancing traffic from interchanges throughout the corridor.
- Traffic volumes at the Lewistown Road/Air Park Road intersection were developed by applying a 2% per year annual growth rate to existing turning movement volumes.
- Turning movement volumes related to the existing truck stop in the northeast quadrant of the Lewistown Road interchange were increased by 20% to reflect increased usage in the future.

Reasonable estimates of 2025 Baseline average annual daily traffic (AADT) were thus prepared for the study area network. Subsequently, AM and PM peak hour volumes were developed by calculating peak hour percentages (of daily traffic) from existing turning movement counts and daily traffic counts. (These calculations assumed that peak hour factors will generally be the same in 2025 as they are today.) The peak hour percentages were then applied to the 2025 daily volumes. This exercise was iterative and required that initial peak hour volumes be adjusted so that traffic was balanced along I-95, on interchange ramps, and at study area intersections.

The result of the above effort was a set of "2025 Baseline" volumes for daily (AADT), AM peak hour, and PM peak hour traffic. The volumes are shown in **Figures 3-15, 3-16, and 3-17**, respectively.



Notes:

1. Volumes are bi-directional with the exception of the I-95 mainline and one-way ramps.
2. 2025 Baseline volumes are based on minor modifications to the output of the 2023 MINUTP Regional Transportation Model.

Figure 3-15

2025 Baseline Daily Traffic Volumes

(Average Annual Daily Traffic)

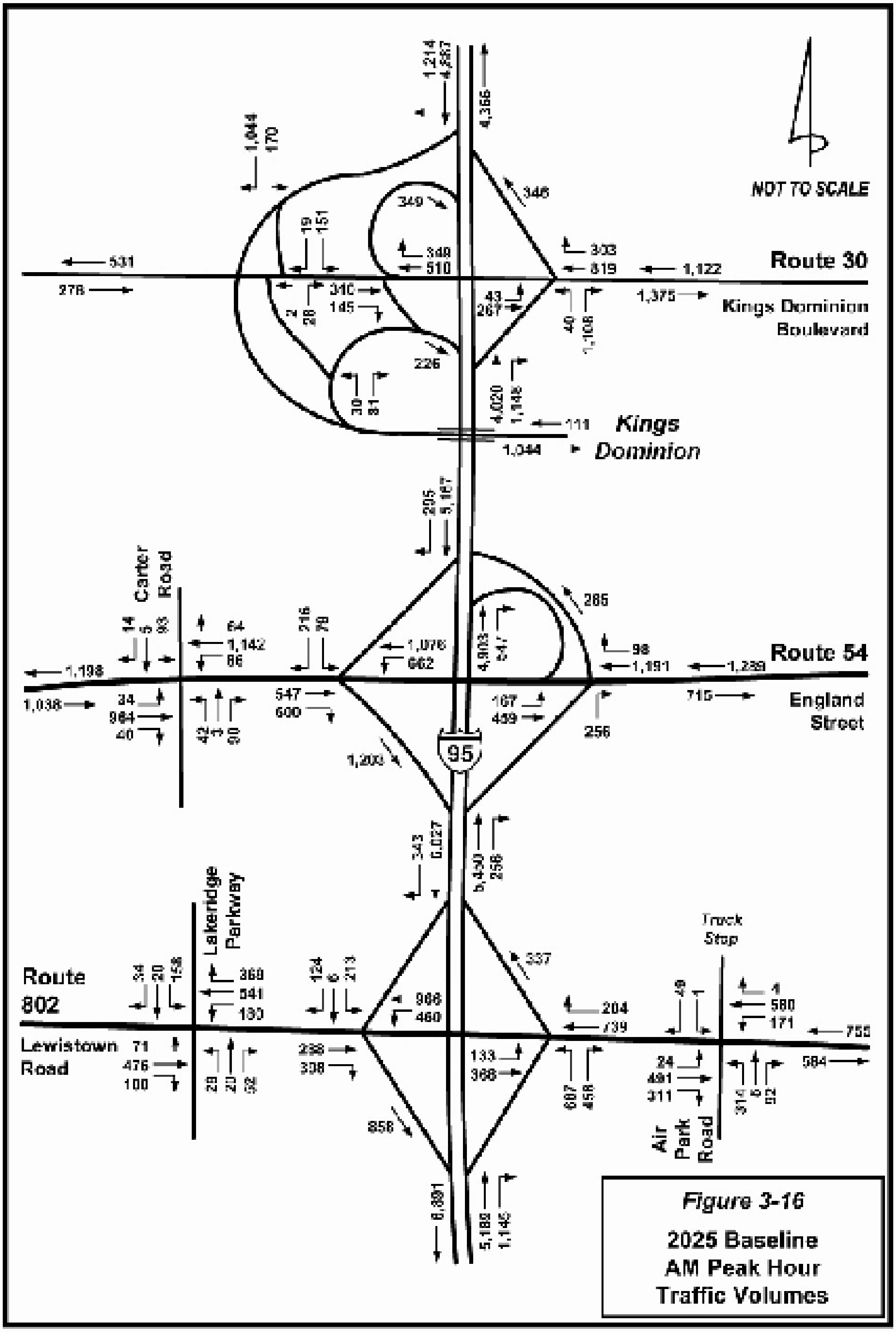


Figure 3-16

2025 Baseline AM Peak Hour Traffic Volumes

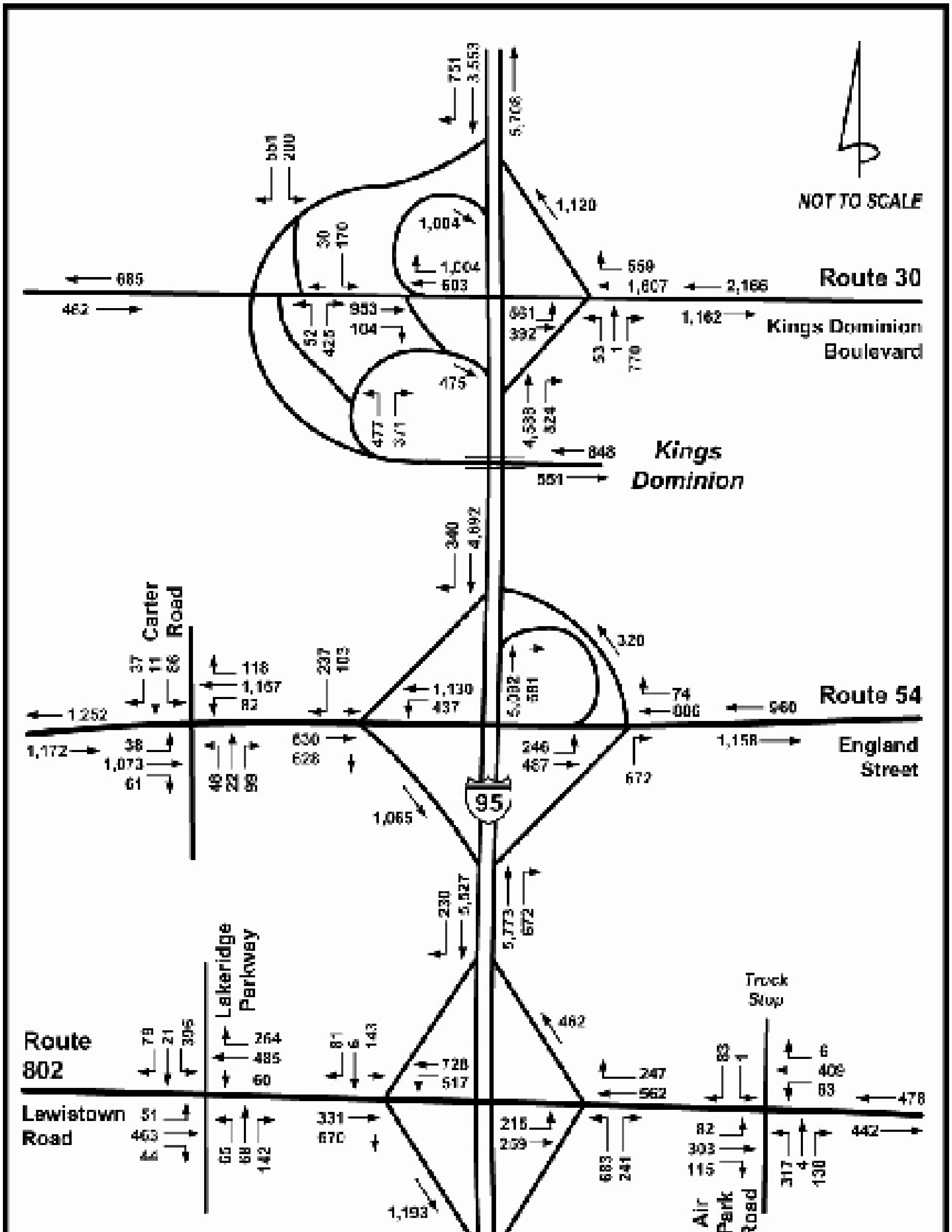


Figure 3-17

2025 Baseline PM Peak Hour Traffic Volumes

3.5.5 2025 Projected (Study) Volumes

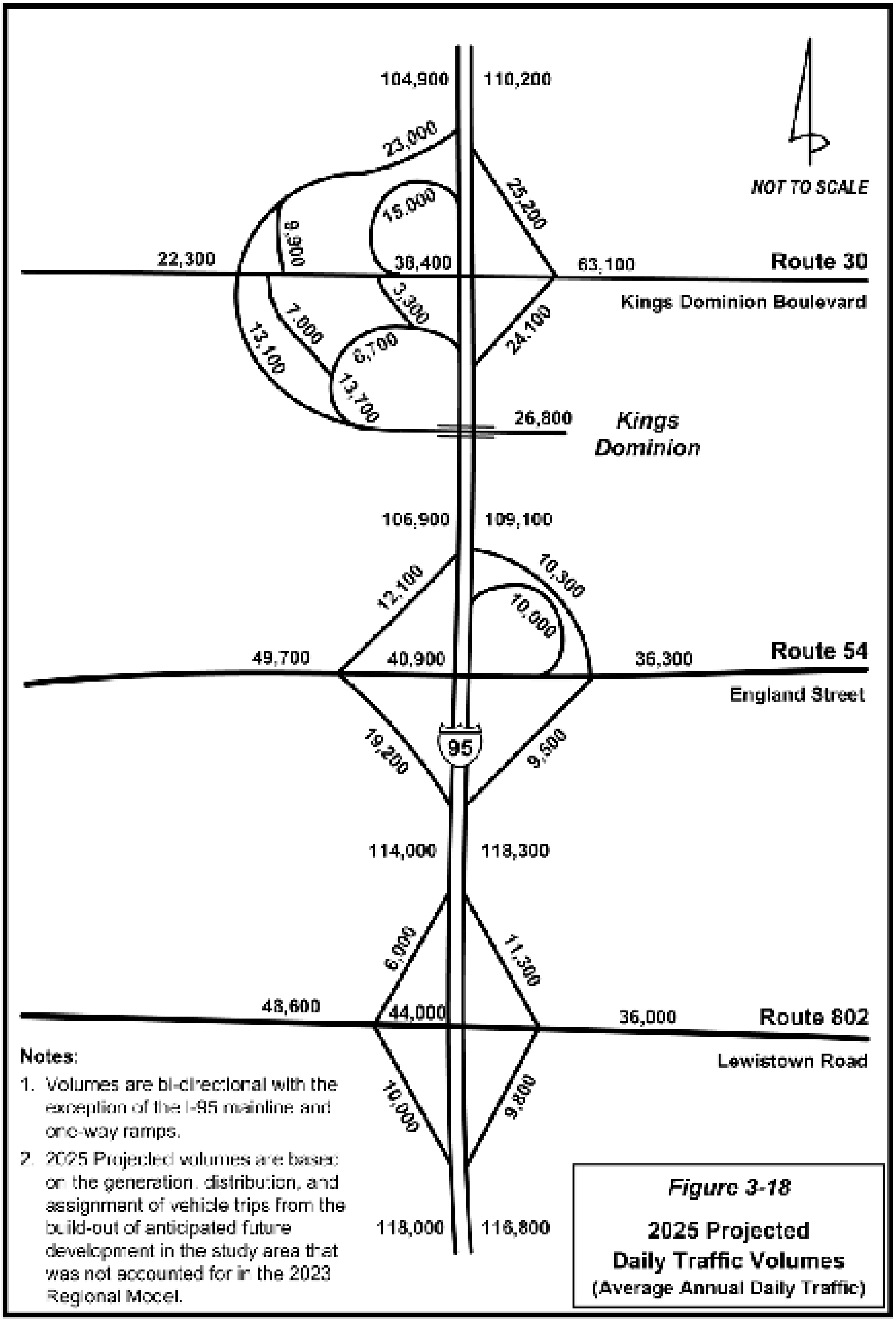
Since 1998, when the original assumptions with respect to socio-economic data and the transportation network were made to develop the regional model, growth patterns and land use plans have changed. With the strong economy of the 1990's, new roadway projects were envisioned and in some cases implemented. Although the 2025 Baseline (model) traffic forecasts represent a considerable level of growth and capacity improvements from existing conditions, discussions with the Town of Ashland, Hanover County, RRPDC, and VDOT resulted in the need for additional modifications to the model output.

To create the "2025 Projected" volumes for use in the I-95 Corridor Study, land use assumptions, transportation network assumptions, and travel pattern/traffic distribution assumptions were altered to better reflect anticipated future conditions. Hanover County and the Town of Ashland identified a number of upcoming development projects and future development areas that were not included in the 1998 model, and thus not in the 2025 Baseline volumes. These projects and development areas were located in the vicinity of Route 802/Lewistown Road/Air Park Road, Route 54/Ashland, and Route 30/Kings Dominion, consistent with the Land Use Plans for Hanover County and Ashland. Development in these areas is anticipated to result in increased traffic on study area roadways of Routes 802, 54, and 30, as well as the I-95 mainline. For the purposes of this study, these 2025 Projected volumes represent build-out conditions the development areas, or a worst case scenario with respect to traffic conditions.

Through a manual AM and PM peak hour assignment of traffic for the development areas, additional traffic was added to the 2025 Baseline volumes. These volumes were adjusted to balance on study area arterials, ramps, and on the I-95 mainline. In addition to development traffic, these updated study volumes included traffic growth attributed to Kings Dominion doubling in size and altering its trip distribution patterns. Based on its planned expansion of the theme park, Kings Dominion anticipates that by 2025, the number of daily visitors will double and that 50% will travel to/from the south and 50% will travel to/from the north.

Once these updated 2025 peak volumes were assigned to the network, the entire network was manually balanced to reflect anticipated shifts in travel patterns due to new roadway extensions such as the extension of Hill Carter Parkway and Lakeridge Parkway and the realignment of Air Park Road and Ashcake Road, in addition to planned improvements to U.S. 1. After making final adjustments to the volumes to represent balanced traffic traveling in anticipated patterns, AM and PM peak hour turning movement counts were used to create projections of daily volumes, using existing peak percentage factors of daily traffic derived from the work in collecting and analyzing 2002 traffic volumes. The 2025 Projected daily (AADT) volumes and the 2025 Projected AM and PM peak hour traffic volumes are shown in **Figures 3-18, 3-19, and 3-20**, respectively.

The result of the analysis of traffic was a set of 2025 AADT and peak hour estimates for the roadway segments of the I-95 corridor study area. The process of deriving the 2002 and 2025 volumes and the projections themselves were reviewed in detail with the TAC members. The analysis is in line with Hanover County's and Ashland's Comprehensive Plans. TAC members approved of the analysis, and consensus was reached on the derived traffic volumes for 2002 Existing volumes, 2025 Baseline volumes, and 2025 Projected volumes. For comparison purposes, these volumes are summarized in Table 3-1.



Notes:

1. Volumes are bi-directional with the exception of the I-95 mainline and one-way ramps.
2. 2025 Projected volumes are based on the generation, distribution, and assignment of vehicle trips from the build-out of anticipated future development in the study area that was not accounted for in the 2023 Regional Model.

Figure 3-18

2025 Projected Daily Traffic Volumes (Average Annual Daily Traffic)

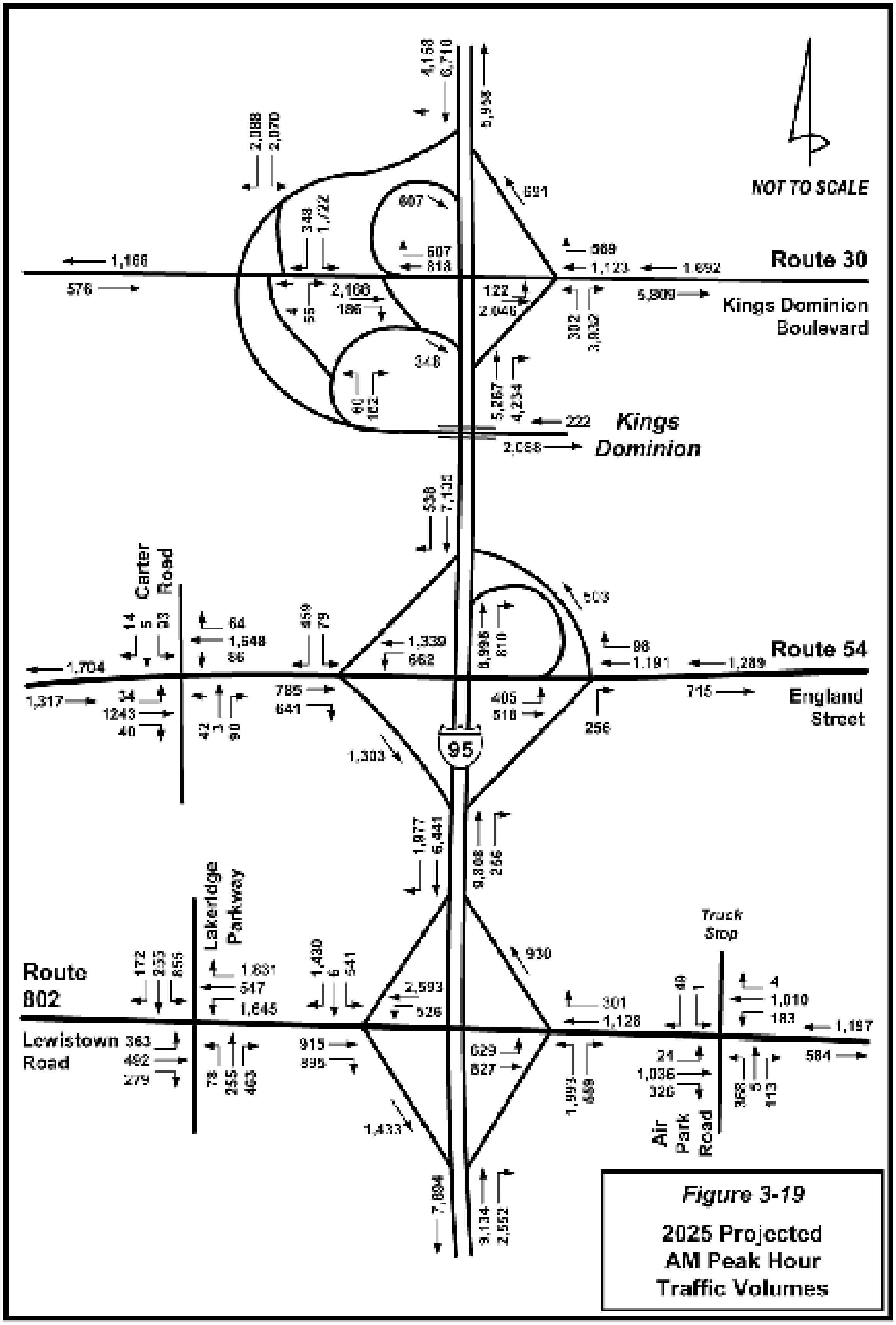


Figure 3-19

2025 Projected AM Peak Hour Traffic Volumes

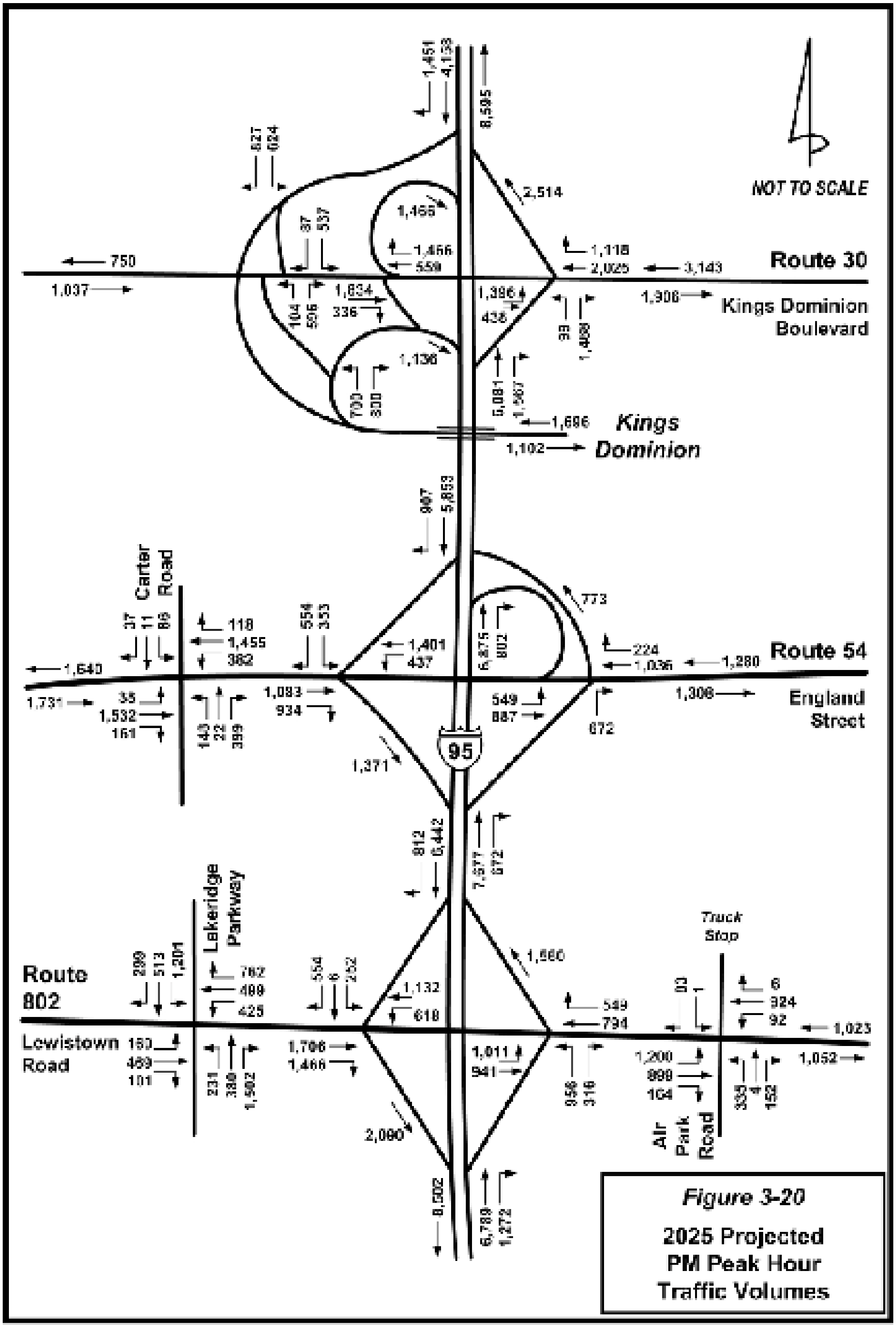


Figure 3-20

2025 Projected PM Peak Hour Traffic Volumes

Table 3-1
Comparison of Traffic Volumes Derived for Study Area

Study Area Segment	Segment Description	2002 Existing AADT [1]	2025 Baseline AADT [2]	2025 Projected AADT [3]
1A	I-95 mainline - NB (Rt 30 to Caroline County Line)	44,500	64,500	110,200
1B	I-95 mainline - SB (Caroline County Line to Rt 30)	44,700	64,500	104,900
2	US 1 from Caroline CL to Rt 30	4,900	19,800	24,500
3	US 1 from Rt 30 to Rt 738 (Old Ridge Rd)	7,500	28,600	37,600
4	Rt 30 from US 1 to SB I-95 ramps	7,000	12,100	22,300
5	Ramp from SB I-95 to Rt 30/KD ramp split	6,100	7,800	23,000
6	Ramp from split of Rt 30/KD ramp to Rt 30	2,400	3,000	9,900
7	Ramp from split of Rt 30/KD ramp to KD west lot (2-way)	6,300	9,100	26,800
8	Ramp from West Lot outbound split to Rt 30	1,200	2,500	7,000
9	Ramp from West Lot outbound split to SB I-95 ramp merge	1,400	1,800	6,700
10	Ramp from Rt 30 EB to SB I-95 ramp merge	800	1,000	3,300
11	Ramp from SB I-95 ramp merge to SB I-95	2,200	2,800	10,000
12	Ramp (loop) from Rt 30 WB to SB I-95	6,900	7,700	15,000
13	Rt 30 from SB I-95 ramps to NB I-95 ramps	19,700	22,500	38,400
14	Ramp from NB I-95 to Rt 30	8,400	10,600	24,100
15	Ramp from Rt 30 to NB I-95	4,700	6,900	25,200
16	Rt 30 from NB I-95 ramps to KD East Lot entrance	24,400	29,400	63,100
17	Ramp (1-Way) from split of Rt 30/KD ramp to KD West Lot	3,700	4,800	13,100
18	Rt 30 from Rt 688 to Caroline County Line	6,600	10,100	18,600
19A	I-95 mainline – NB from Rt 54 to Rt 30	48,200	68,200	109,100
19B	I-95 mainline - SB from Rt 30 to Rt 54	47,700	67,200	106,900
20	US 1 from north Ashland to Rt 54	18,000	32,600	38,500
21	US 1 from Rt 54 to Rt 657 (Ashcake Rd)	20,000	27,100	34,400
22	Rt 54 from US 1 to Cottage Greene Dr	20,700	25,300	42,100
23	Rt 54 from Cottage Greene Dr to I-95 SB ramps	24,700	30,300	49,700
24	Ramp from I-95 SB to Rt 54	4,600	6,900	12,100
25	Ramp from Rt 54 to I-95 SB	9,400	16,300	19,200
26	Rt 54 from I-95 SB ramps to I-95 NB ramps	12,500	21,400	40,900
27	Ramp from I-95 NB to Rt 54 EB	1,500	7,100	9,500
28	Ramp from I-95 NB to Rt 54 WB (loop ramp)	6,700	8,400	10,000
29	Ramp from Rt 54 to I-95 NB	4,100	6,400	10,300
30	Rt 54 from I-95 NB ramps to Rt 301	4,000	17,100	36,300
31A	I-95 mainline - NB from Rt 802 (Lewistown Rd) to Rt 54	52,300	77,300	118,300
31B	I-95 mainline - SB from Rt 54 to Rt 802	52,500	76,600	114,000
32	US 1 from Rt 657 to Rt 802	15,000	23,900	36,500
33	US 1 from Rt 802 to Rt 656 (Sliding Hill Rd)	15,000	27,400	40,100
34	Rt 802 from US 1 to I-95 SB Ramps	7,000	11,800	48,600
35	Ramp from I-95 SB to Rt 802	2,400	3,800	6,000
36	Ramp from Rt 802 to I-95 SB	5,900	11,300	10,000
37	Rt 802 from I-95 SB ramps to I-95 NB ramps	6,300	14,500	44,000
38	Ramp from I-95 NB to Rt 802	6,600	11,400	9,800
39	Ramp from Rt 802 to I-95 NB	2,900	5,200	11,300
40	Rt 802 from I-95 NB Ramps to Rt 657 (Ashcake Rd)	5,400	15,500	36,000
41A	I-95 mainline – NB from Rt 656 to Rt 802	56,000	83,500	116,800
41B	I-95 mainline - SB from Rt 802 to Rt 656	56,000	84,100	118,000
42	Rt 657 (Ashcake Rd) west of US 1	6,200	10,600	16,900
43	Rt 657 from US 1 to Ashland ECL	6,600	9,700	14,500
44	Rt 657 from Ashland ECL to Rt 659 (Cheroy Rd)	4,700	8,900	13,700
45	Rt 657 from Rt 659 to Rt 802	4,800	9,800	14,600
46	Rt 657 from Rt 802 to Rte 654 (Stumpy Rd)	2,000	12,600	15,600
47	Rt 657 from Rt 654 to US 301	1,400	8,200	11,200
48	Air Park Road south of Route 802	6,200	6,800	8,100

Notes:
1. 2002 Existing volumes are based on data collected in the field and obtained from VDOT and recently published studies.
2. 2025 Baseline volumes are based on minor modifications to output from 2023 MINUTP Regional Transportation Model.
3. 2025 Project volumes are on the generation, distribution, and assignment of vehicle trips from build-out of anticipated future development in the study area that was not accounted for in the 2023 Regional Transportation Model.

3.6 Traffic Safety and Crash History

The study team researched the vehicle crash history of the study area, obtaining data maintained by VDOT, as described in Section 2 of this report. A traffic safety and crash analysis for three years of data (January 1, 1999 through December 31, 2001) was conducted for I-95, Route 802, Route 54, and Route 30. It is important to note that crashes often go unreported. Only reported crashes in the study area were included in this analysis.

The majority of crashes on I-95 occur at and adjacent to study area interchanges. In the 3-year study period, 731 crashes, or 79% of all crashes in the study area, occurred on I-95. These crashes were primarily rear-end and sideswipe collisions attributable to ramp-related vehicle movements. The location that experienced the highest crash frequency was the section of I-95 in the vicinity of the Route 802 (Lewistown Road) interchange, where 120 crashes were reported in the 3-year period. Of the crashes at this location, the majority were reported as rear-end, sideswipe, and fixed object crashes.

On the arterial streets a different pattern of crashes was apparent. Rear-end crashes were relatively common, but they were usually not severe. Instead, angle collisions were frequent and often more severe. Within the study area, Route 54 (England Street) experienced the highest crash frequency with 118 reported crashes in 3 years. Of the 118 crashes on this roadway, rear-end (31%) and angle collisions (25%) were the most common.

Figure 3-21 presents a summary of crashes by type throughout the entire study area. The two most common types of collisions were rear-end (37%) and fixed object (32%) crashes. **Tables 3-2** summarizes the crash data and crash rates. The rates are based on 100 million vehicle miles of travel (VMT). Note that the crash, injury, and death rates are general higher in this corridor than statewide rates, especially for northbound I-95. **Table 3-3** presents a summary of study area crashes by roadway and by crash type. An analysis of this data for each roadway is discussed below.

Figure 3-21—Study Area Crash Type Distribution

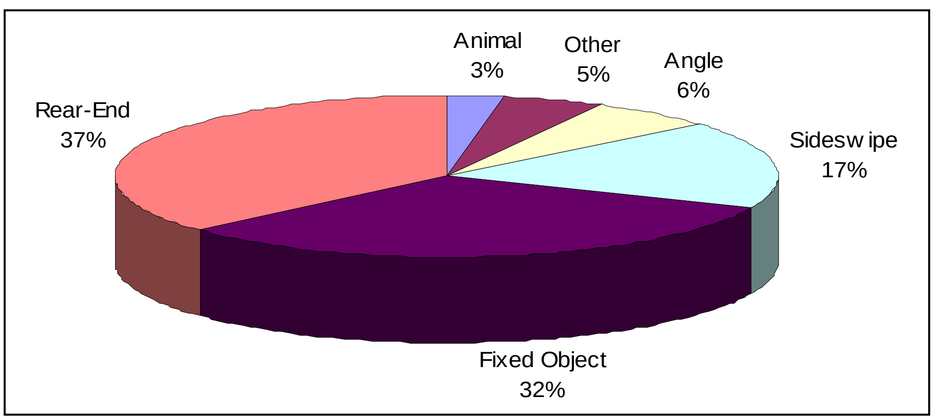


Table 3-2—Summary of Crash Data (January 1999-December 2001)

Road Segment	Total Crashes				Injury Crashes				Fatal Crashes			
	# Crashes	Segment Rate *	Statewide Rate	% Diff	# Injuries	Segment Rate *	Statewide Rate	% Diff	# Deaths	Segment Rate *	Statewide Rate	% Diff
I-95 NB	354	86	72	120%	184	54	38	143%	6	1.77	0.6	296%
I-95 SB	377	107	72	148%	226	67	38	176%	2	0.59	0.6	99%
Rte 30	49	435	157	277%	33	293	100	293%	0	0.00	1.6	0%
Rte 54	118	322	157	205%	17	47	100	47%	0	0.00	1.6	0%
Rte 802	30	409	157	260%	9	123	100	123%	0	0.00	1.6	0%

* Segment rates were computed using published year 2000 VDOT AADT volumes. Rates are indicated in terms of 100 million vehicle miles

Table 3-3—Study Area Roadway Crash Distribution (by type)

Type of Crash	Facility				Total Number of Crashes
	I-95	Route 802	Route 54	Route 30	
Angle	3	16	30	7	**56**
Deer	13	2	10	1	**26**
Fixed Object (in road)	7	0	0	1	**8**
Fixed Object (off road)	253	5	23	10	**291**
Head on	0	0	1	0	**1**
Non Collision	19	0	6	1	**26**
Other	15	0	2	0	**17**
Rear-End	277	5	36	21	**339**
Sideswipe (opposite direction)	1	0	7	1	**9**
Sideswipe (same direction)	143	2	1	7	**153**
Train	0	0	2	0	**2**
Totals	**731**	**30**	**118**	**49**	**928**

3.6.1 I-95 Mainline

Rear-end (277 of 731, or 38%), fixed object (253 of 731, or 35%), and sideswipe (143 of 731, or 20%) collisions were the most common types of crashes experienced on I-95 in the study area. These types of crashes were most frequent at and immediately adjacent to study area interchanges. It can be concluded that periodic congestion, substandard (vertical and horizontal) bridge clearances, significant volumes of heavy vehicles (which accelerate and decelerate more slowly than passenger cars), and interchange geometry deficiencies (with respect to current traffic volumes and today's design standards) contribute to the frequency of these types of crashes in the corridor.

I-95/Route 802 interchange: This interchange experiences numerous rear-end, sideswipe, and fixed object crashes. The tight diamond configuration of this interchange, very similar to the Route 54 interchange, provides long acceleration and deceleration lanes adjacent to the freeway with short ramps. The perception of a short ramp causes vehicles to merge and diverge at speeds less than prevailing freeway speeds, increasing the potential for rear-end collisions to occur. As vehicles change lanes, and in some cases swerve, to avoid these slower moving vehicles, the frequency of sideswipe and fixed object crashes has the potential to increase. Potential countermeasures include:

- Increasing the separation between acceleration lanes and the freeway mainline by widening the gore area and using increased striping to better channelize merging vehicles

- Increasing the separation between deceleration lanes and the freeway mainline by shortening diverge area (not shortening the overall length of the deceleration lane) and using increased striping to channelize diverge movements

- Increasing enforcement to monitor vehicle speeds

- Adding collector-distributor roads to separate weaving traffic (for merges and diverges) from through traffic

I-95/Route 54 interchange: This interchange experiences frequent rear-end and sideswipe crashes on northbound and southbound I-95, primarily on the south side of the interchange. In the southbound direction, there were numerous rear-end crashes upstream of the south-bound entrance ramp. Although off-ramps at this interchange provide adequate decelera-tion and acceleration lane length, the majority of the lane length is immediately adjacent to the freeway mainline, rather than separated after a gore point. This condition is a potential factor in the relative frequency of rear-end and sideswipe crashes. Rather than vehicles exiting and entering the freeway at prevailing freeway speeds, vehicles slow in the right-hand travel lane (when exiting) and do not fully accelerate to freeway speeds (when merging), exposing them to collision from the rear from an unsuspecting driver. Potential countermeasures include:

- Increasing the separation between acceleration lanes and the freeway mainline by widening the gore area/using increased striping to better channelize merging vehicles

- Increasing the separation between deceleration lanes and the freeway mainline by shortening diverge area (not shortening the overall length of the deceleration lane) and using increased striping to channelize diverge movements

- Increasing enforcement to monitor vehicle speeds

- Adding collector-distributor roads to separate weaving traffic (for merges and diverges) from through traffic

I-95/Route 30 interchange: The southbound ramps experience frequent and sometimes severe rear-end collisions, potentially attributable to queues that form on this ramp related to inbound volumes and/or parking collection delays for Kings Dominion. In addition, in the southbound direction, immediately upstream of the merge points for the southbound loop ramps, rear-end crashes are frequent, which is potentially attributable to inadequate ramp length to permit vehicles to accelerate to freeway speeds, inadequate sight distance for vehicles merging with freeway traffic or inadequate gaps on the freeway to accommodate merging traffic safely. Potential countermeasures to mitigate crashes include:

- Removing/clearing vegetation on southbound on-ramps to improve ramp to freeway sight distance and freeway to ramp visibility

- Increasing enforcement to monitor vehicle speeds and tailgating

- Increasing acceleration lane length to provide additional distance for vehicle merging

- Adding collector-distributor roads to separate weaving traffic (for merges and diverges) from through traffic

North of the southbound off-ramp (at the Route 30 interchange), fixed object, rear-end, and sideswipe collisions were common. During peak operating periods of Kings Dominion, parking fee collection sometimes causes traffic on the southbound exit ramp to queue onto the freeway. This creates a hazardous condition where ramp traffic is stopped or moving slowly adjacent to a free flowing freeway travel lane. This speed differential creates a hazardous condition. Potential mitigation measures include:

- Revising parking fee collection practices for Kings Dominion to prevent extensive queuing on the southbound ramp

- Extending and separating the existing deceleration lane from the freeway mainline to provide additional storage for queued vehicles and create space between queued vehicles and the freeway mainline

Similar to the southbound off-ramp at the Route 30 interchange, the northbound off-ramp is subject to park-related queues and vehicle delays that extend onto the northbound freeway mainline. Potential mitigation measures include:

- Providing additional ramp storage and separation between the deceleration lane and the freeway mainline

- Revising parking fee collection practices to prevent queuing on the northbound ramp

3.6.2 Route 802 (Lewistown Road)

Angle crashes (16 of 30, 53 percent) were the most common type of crash experienced at this location and are often the result of drivers misjudging the speed and/or distance of oncoming traffic and mistakenly turning in front of or into an oncoming vehicle. This crash type is likely to occur in the following situations:

- At unsignalized intersections

- When drivers disregard or fail to see or obey a traffic control device such as a stop or yield sign or traffic signal

- When speed limits are not observed

- When inadequate sight distance exists due to a physical obstruction or geometric condition (e.g., steep grade or sharp curve)

The majority of angle collisions experienced occurred at the Lewistown Road/I-95 northbound and southbound ramp intersections. These intersections are currently unsignalized, have sight distance issues due to vegetation and vertical geometry (bridge is on a vertical curve higher than the ramp intersections), and do not have exclusive left-turn lanes. Potential improvements to mitigate this type of crash include:

- Removing sight distance obstructions—clearing vegetation and removing any physical obstructions
- Providing exclusive left-turn lanes on eastbound and westbound Lewistown Road at the I-95 ramps
- Installing traffic signals at Lewistown Road/I-95 northbound and southbound ramp intersections—currently planned
- Providing a protected left-turn phase at newly signalized intersections

In addition to these improvements helping to mitigate angle collisions, they also have the potential to reduce the number of rear-end crashes. By providing positive traffic control (traffic signal) and exclusive left-turn lanes, fewer through lane blockages will occur on Lewistown Road and roadway congestion will be reduced.

3.6.3 Route 54 (England Street)

Rear-end collisions (36 of 118, or 31%), followed by angle collisions (30 of 118, or 25%) were the two most common types of crashes experienced on Route 54. The majority of angle and rear-end collisions occurred at signalized and unsignalized intersections and median crossover points. Rear-end crashes commonly occur at locations that experience periods of congestion. These collisions are often the result of sudden stops in combination with inadequate following distance—two common occurrences during periods of traffic congestion. Potential countermeasures to help mitigate crashes on Route 54 include:

- Providing a left-turn bay on westbound Route 54 at the Route 54/I-95 southbound ramp intersection
- Installing a traffic signal at the Route 54/I-95 southbound ramp intersection
- Installing a coordinated signal system along Route 54, from I-95 to U.S. 1, to reduce the number of stops individual through vehicles are forced to make (improves traffic flow/reduces congestion)

3.6.4 Route 30 (Kings Dominion Boulevard)

Rear-end collisions (21 of 49, or 43%) were the most common type of crash experienced at this location. Complicated and potentially confusing interchange geometry in combination with inadequate sight distance at several studied locations contribute to the number of angle (7 of 49, or 14%) and sideswipe (7 of 49, or 14%) collisions. The Route 30/I-95 southbound ramp intersection was a location of particular concern. This location has sight distance issues related to overgrown vegetation, as well as the vertical curve of the bridge immediately west of the intersection. Potential countermeasures to help mitigate crashes on Route 30 include:

- Providing a traffic signal at the Route 30/I-95 southbound ramp intersection

- Streamlining the collection of parking fees at Kings Dominion gates to minimize the formation of queues that are frequently experienced on I-95 northbound and southbound exit ramps

- Improving signal phasing and timing at the Route 30/Theme Park Way intersection to reduce eastbound/westbound traffic queues during peak loading and unloading periods of Kings Dominion

With the analysis and conclusions discussed above, traffic safety and crash history for the study area has been considered by this study. It should be noted that the direct relationship between traffic congestion and crash frequency should provide added impetus to ongoing efforts to provide funding for near- and long-term transportation projects that minimize traffic congestion in the study area.

In addition, while the scope of this study did not include a detailed estimate of the benefits that would be derived from the implementation of improvements, the members of the TAC agreed that both mid-term and long-term improvements would contribute greatly to the safety of the I-95 mainline and its interchanges with Routes 802, 54, and 30. The improvements would result in realized economic savings for the traveling public and the Commonwealth of Virginia.

3.7 Operations Analysis

With the derivation of traffic volumes for each of the roadway segments within the study area, and the quantification of geometric characteristics through the base mapping process, detailed analysis of traffic operations was possible. This analysis included:

- Highway Capacity Software (HCS) and Level of Service (LOS) analysis
- Highway Capacity Manual (HCM) formula applications
- CORSIM and SYNCHRO analysis

An analysis of AM and PM peak hour traffic volumes was completed using existing geometry for the freeway mainline, ramps, and connecting roadways (surface streets). The following freeway sections, ramps, connecting roadways, and at-grade intersections have been analyzed as a part of this analysis:

<u>I-95 Mainline Sections - northbound (NB) and southbound (SB)</u>
- From the Hanover/Caroline County line to Route 30 (plus areas influenced by the Kings Dominion interchange)
- From Route 30 to Route 54 (plus areas influenced by the Route 54 interchange)
- From Route 54 to Route 802 (plus areas influenced by the Route 802 interchange)
- From Route 802 to Route 656 (Sliding Hill Road)

<u>Ramps</u>
- Route 30 ramps
- Route 54 ramps
- Route 802 ramps

Connecting Roadways

- Route 30 from U.S. 1 to east of the Kings Dominion Gate along Route 30
- Route 54 from west of I-95 SB exit ramp to east of I-95 NB exit ramp
- Route 802 from west of Lakeridge Parkway to Ashcake Road

Intersections

- Route 30/I-95 SB Ramps
- Route 30/I-95 NB Ramps
- Route 54/Carter Road
- Route 54/I-95 SB Ramps
- Route 54/I-95 NB Ramps
- Route 802/Lakeridge Parkway
- Route 802/I-95 SB Ramps
- Route 802/I-95 NB Ramps
- Route 802/Air Park Road

Operational analyses were evaluated and quantified using Highway Capacity Manual Level of Service (LOS) criteria. LOS A through LOS F defines the full range of driving conditions, from best to worst. The LOS is based on relationships of operating speed to volume/capacity ratio. LOS A represents free-flowing conditions, with low density and with no restriction due to traffic volumes. LOS B, the lower level that is often used for design of rural highways, is the zone of stable flow with some slight restriction of driver freedom. LOS C denotes the zone of stable flow with more marked driver constraint, and is often the LOS used for design of urban highways. LOS D reflects little freedom for driver maneuverability, and while operating speeds are still tolerable, the condition of unstable flow is being approached. Low operating speed and volumes at or near capacity occur in LOS E. LOS F exhibits frequent interruptions to flow, low operating speeds, and volumes well in excess of capacity.

3.7.1 Freeway Mainline Operations

On the I-95 mainline, current year (2002) AADT volumes for non-holiday periods range from approximately 90,000 vehicles per day (vpd) to just over 110,000 vpd. The *Highway Capacity Manual 2000* indicates that a 6-lane freeway facility with a free-flow speed of 70 mph has the ability to carry approximately 14,400 vehicles per hour at LOS E (at-capacity). On this section of I-95, from the analysis during this study, it was determined that the AM peak hours represent approximately 5% (5,500) of the daily volume in the AM peak hour, or better than LOS B, and 7% (7,700) of the daily volume in the PM peak hour, or LOS B/C.

More specific freeway mainline levels of service were determined by calculating vehicle density (passenger cars per mile per lane, or pc/mi/ln). Density calculations include factors that adjust the actual volumes to account for the number of lanes, lane width, lateral clearance to obstructions, proportion of heavy vehicles, and terrain profile (flat, rolling, grade, etc.).

3.7.2 Ramp Operations

Geometric deficiencies were noted for ramps throughout the study area. Similar to freeway mainline segments, level of service calculations for merge and diverge points were based on vehicle density. Principal factors that influenced the capacity in the merge were the following:

- Total freeway flow approaching the merge area
- Total ramp flow
- Total acceleration lane length
- Free-flow speed of the ramp at the merge point

When determining the capacity of a diverge, the following factors were considered and calculated:

- Approaching flow in the right-hand (unless left-hand ramp) two lanes of the freeway
- Capacity of the freeway segment in the ramp influence area
- Density of flow within the ramp influence area

3.7.3 CORSIM and SYNCHRO

Traffic engineers today are tasked with more than just the problem of how to move vehicles. They must also optimize existing transportation resources to safely and efficiently move people and goods through the community. These demands have created an increased reliance on analytical tools associated with transportation simulation models. Models such as CORSIM and SYNCHRO make it possible for transportation planners and traffic engineers to quickly evaluate the impacts of numerous traffic control and management strategies on the transportation system's operational performance.

The abilities of the simulation models to test multiple concepts and strategies allows planners and engineers to identify weaknesses in concepts and narrows the field of possible concepts to a select few before further study is necessary. In addition, the simulation model can enhance the project or alternative selection process. During this study, CORSIM allowed the analyst to evaluate the interaction between the existing local network and the freeway network for reasonableness. The modeling also allowed the team to evaluate the effectiveness of various modifications to the existing interchanges. SYNCHRO provided the team with tools to evaluate traffic operations at signalized and unsignalized intersections along the primary and secondary roads within the study area.

For this interchange study, HCM, HCS, CORSIM, and SYNCHRO tools were used in the analysis of existing (2002) and future year (2025) traffic conditions to measure the effectiveness of the following networks:

- Year 2002 Existing Network
- Year 2025 No-Build Network (based on current plans)
- Year 2025 Master Plan Network (based on recommendations of this corridor study)

Computer screen images were captured for each of the CORSIM networks, showing simulated traffic conditions at each of the three interchanges. These images are included in **Appendix D** of this report.

3.7.4 Summary of Operations Analysis

Comparing the current year analysis with the future year analysis on the no-build network, **Table 3-4** summarizes the results of the analysis described above for I-95 mainline segments. **Table 3-5** provides a similar summary for the interchange ramps. Note that 2002 Existing volumes (discussed in Section 3.5.1) were applied to the existing 2002 transportation network to result in the levels of service shown. Note also that 2025

Projected volumes (discussed in Section 3.5.5) were applied to the 2025 No-Build network to result in the levels of service shown.

Table 3-4—I-95 Mainline Levels of Service
Comparison of Year 2002 Existing vs. Year 2025 No-Build Conditions

	Freeway Segments	Level of Service			
		2002		2025 No-Build	
		AM	PM	AM	PM
I-95 Northbound					
1	South of Route 802	C	C	D	F
2	Route 802 to Route 54	C	C	D	F
3	Route 54 to Route 30	C	C	C/D	F
4	North of Route 30	B	B	C/D	F
I-95 Southbound					
1	North of Route 30	C	B	C/D	F
2	Route 30 to Route 54	C	B	C/D	F
3	Route 54 to Route 802	C	B/C	D	F
4	South of Route 802	C	B	D	F

Notes:

1. 2002 Existing volumes (discussed in Section 3.5.1) were applied to the existing 2002 transportation network to result in the levels of service shown.
2. 2025 Projected volumes (discussed in Section 3.5.5) were applied to the 2025 No-Build network to result in the levels of service shown.

Table 3-5—Interchange Merge and Diverge Levels of Service
Comparison of Year 2002 Existing vs. Year 2025 No-Build Conditions

	Ramp Merge/Diverge	Level of Service			
		2002		2025 No-Build	
		AM	PM	AM	PM
I-95 Northbound					
1	Route 802 diverge	C	C	F	F
2	Route 802 merge	C	C	F	F
3	Route 54 diverge eastbound	C	C	D	D
4	Route 54 diverge westbound	C	C	D	D
5	Route 54 merge	C	B	D	D
6	Route 30 diverge	D	C	F	D
7	Route 30 merge	C	B	F	F
I-95 Southbound					
1	Route 30 diverge	D	D	F	F
2	Route 30 merge from westbound	C	C	F	D
3	Route 30 merge from eastbound Route 30 and KD fly over	C	C	F	D
4	Route 54 diverge	C	C	F	D
5	Route 54 merge	C	C	F	D
6	Route 802 diverge	C	C	F	D
7	Route 802 merge	C	C	F	D

3.7.5 Year 2002 Existing Conditions

In general, the I-95 mainline today operates at LOS C or better. However, the mainline is saturated with traffic for 12 to 14 hours each day. During peak travel periods or holidays, or when incidents occur, traffic operations can rapidly worsen and can often be described as slow-and-roll or stop-and-go.

Looking at traffic operations at the study area interchanges, with the exception of the southbound diverge at Route 30, merges and diverges in the study area function today at LOS C or better during the AM and PM peak hours. The southbound diverge at Route 30 operates at LOS D during the AM peak hour. Again, because of the sheer volume of traffic, minor incidents can quickly create LOS F conditions.

3.7.6 Year 2025 No-Build Conditions

"No-Build" conditions for the purposes of this corridor study imply that no mainline widening or major interchange improvements will take place prior to 2025. Only those improvements listed in the Comprehensive Plans of Hanover County and the Town of Ashland, as well as those listed in the *constrained* 2023 Richmond Area Long-Range Transportation Plan (LRTP), were considered in the No-Build network. No interchange improvements are planned, nor is widening of the I-95 mainline planned. Thus, the specific improvements in the No-Build network included the following projects:

- Widen Route 802 to a four-lane median-divided facility from Lakeridge Parkway to the I-95 southbound ramps
- Widen Route 802 to a four-lane median-divided facility from the I-95 northbound ramps to realigned Ashcake Road
- Realign Air Park Road to tie directly to realigned Ashcake Road
- Realign Ashcake Road to tie directly to Air Park Road
- Extend Lakeridge Parkway to the north and the south
- Widen Route 54 to 6 lanes from US 1 to the I-95 southbound ramps
- Implement a coordinated signal system on England Street from US 1 to the I-95 northbound ramps
- Extend Hill Carter Parkway from its existing location to Route 54
- Widen Route 30 from US 1 to the I-95 southbound off-ramp

The analysis of Year 2025 no-build conditions included the application of the Year 2025 Projected (study) traffic volumes on a network of roadways that realizes very few capacity improvements in the next 20 years. As expected, given a 6-lane section on I-95 in 2025, future year traffic volumes applied to the no-build network result in LOS D through F.

3.7.7 Year 2025 Master Plan Conditions

"Master Plan" conditions for this study are those that result from the improvements recommended in Section 4 of this report. The analysis of Year 2025 Master Plan conditions, including the application of Year 2025 Projected traffic, was completed during the development of the Master Plan of Preferred Concepts. These efforts and the results of the analysis are discussed in Section 4.

3.7.8 Additional HCM Analysis

Applying LOS Criteria for Basic Freeway Segments (Exhibit 23-2 of the Highway Capacity Manual) sheds light on the need for additional lanes on I-95. Using the maximum service flow rate per lane (PCPHPL) for a given free-flow speed of 70 mph, the number of lanes required for LOS C or LOS D can be calculated. This direct calculation assumes a basic freeway segment (12-ft lanes, minimum clearances, relatively flat terrain, etc.), such as this study area length of I-95. The calculation also takes into account an increase in AADT due to a 15% volume of truck traffic and a 1.5 passenger car equivalent factor. This exercise was done to show the need to accommodate the very large volumes of traffic that are projected on the mainline in 2025. This HCM analysis is summarized below.

Table 3-6 lists the maximum service flow rate in passenger cars per hour per lane for each LOS, given a free-flow speed (FFS) of 70 mph. **Table 3-7** calculates the number of lanes in each direction needed for LOS C and LOS D conditions, given the 2002 Existing AADT (from Table 3-5) and a ratio of peak hour traffic to daily traffic of 7%, a 15% truck percentage, and a passenger car equivalent factor for trucks of 1.5. As shown, the three lanes that exist in each direction today are adequate, given this basic freeway segment.

Table 3-6
Max Service Flow Rate per Lane
(PCPHPL) (per *HCM 2000*)

LOS	70 mph FFS
B	1260
C	1770
D	2150
E	2400

Table 3-7
Year 2002 Required Number of Lanes per LOS C and D

I-95 Mainline AADT	2002 AADT	Peak Hour	Number of Lanes LOS C	Number of Lanes LOS D
I-95 NB (Rt 656 to Rt 802)	56,000	4,210	2.4	2.0
I-95 SB (Rt 656 to Rt 802)	56,000	4,210	2.4	2.0
I-95 NB (Rt 802 to Rt 54)	52,300	3,940	2.2	1.8
I-95 SB (Rt 802 to Rt 54)	52,500	3,950	2.2	1.8
I-95 NB (Rt 54 to Rt 30)	48,200	3,630	2.0	1.7
I-95 SB (Rt 54 to Rt 30)	47,700	3,590	2.0	1.7
I-95 NB (Rt 30 to Caroline Co. Line)	44,500	3,350	1.9	1.6
I-95 SB (Rt 30 to Caroline Co. Line)	44,700	3,360	1.9	1.6

Ratio of Peak Hour traffic to AADT = 7%
Truck percentage = 15%
Passenger car equivalent factor = 1.5
Peak hour calculation: AADT X 7% X 1.075 (derived from Peak Hour – 15% + (15% X 1.5))
Number of lanes = Peak Hour / Max Service Flow Rate Per Lane (from Table 3-6)

Table 3-8 calculates the number of lanes in each direction needed for LOS C and LOS D conditions, given the 2025 Projected AADT (from Table 3-5) and a ratio of peak hour traffic to daily traffic of 7%, a 15% truck percentage, and a passenger car equivalent factor for trucks of 1.5. As shown in **Table 3-8**, the three lanes that exist in each direction today will not provide the capacity to support the projected volumes. Depending on the LOS required by FHWA for future design of the I-95 mainline, 4 or 5 lanes will be required in each direction.

Table 3-8 – Year 2025 Required Number of Lanes per LOS C and D

I-95 Mainline AADT	2025 AADT	Peak Hour	Number of Lanes	
			LOS C	LOS D
I-95 NB (Atlee Elmont to Rt 802)	116,800	8,790	5.0	4.1
I-95 SB (Atlee Elmont to Rt 802)	118,000	8,880	5.0	4.1
I-95 NB (Rt 802 to Rt 54)	118,300	8,900	5.0	4.1
I-95 SB (Rt 802 to Rt 54)	114,000	8,580	4.8	4.0
I-95 NB (Rt 54 to Rt 30)	109,100	8,210	4.6	3.8
I-95 SB (Rt 54 to Rt 30)	106,900	8,040	4.5	3.7
I-95 NB (Rt 30 to Caroline Co. Line)	110,200	8,290	4.7	3.8
I-95 SB (Rt 30 to Caroline Co. Line)	104,900	7,890	4.5	3.7

Ratio of Peak Hour traffic to AADT = 7%
Truck percentage = 15%
Passenger car equivalent factor = 1.5
Peak hour calculation: AADT X 7% X 1.075 (derived from Peak Hour – 15% + (15% X 1.5))
Number of lanes = Peak Hour / Max Service Flow Rate Per Lane (from Table 3-6)

3.8 Summary of Findings

Findings from this study have emerged from the review of existing data, observations of existing conditions, and an understanding of the projected land use in the study area. These findings were also the result of the development of future traffic volumes and the analysis of future conditions. The findings were supported by feedback from stakeholders and the members of the study's TAC.

Findings of the I-95 Corridor Study can be summarized into the following set of general issues:

Existing Conditions:

- The I-95 corridor today is approaching capacity.
- Level of service is greatly affected by incidents.
- Traffic volumes increase during AM business hours and stay heavy well into the evening. This daily peak lasts 12-14 hours.

- Traffic on Friday, Saturday, and Sunday is generally heavier than the rest of the week.
- A majority of the traffic is interstate and inter-regional, passing through Hanover County and the Town of Ashland.
- U.S. Routes 1 and 301 serve as diversion routes to I-95 when backups occur due to high traffic volumes or incidents.
- Crashes in the study area are generally volume related.
- Crash rates in the study area are higher than state averages.
- Geometric deficiencies are minimal, except for vertical and horizontal clearances at some of the bridges in the corridor.
- Traffic volumes today exceed the capacity, as originally designed, along the mainline and at the interchanges.
- Mainline truck traffic is 15% to 20% of the volume exceeds the 10% level that the interstate system was envisioned to carry. (As a comparison, that I-81 in Virginia is carrying up to 35% trucks, where separate lanes are being considered by VDOT.)
- The increased ratio of trucks to cars creates safety concerns associated with the different operational characteristics of vehicle types.

Future Conditions:

- Traffic in the study area is expected to grow significantly by 2025, due to increases in inter-regional travel through the study area, and due to development growth along the I-95 corridor in Hanover County and the Town of Ashland.
- Levels of service are expected to worsen by 2025.
- Projected increases in traffic on I-95, freeway ramps, and arterials will not be able to be accommodated by improvements identified in the no-build scenario.
- The I-95 mainline will experience extended periods of stop-and-go and slow-and-roll traffic due to over-saturation of traffic on the mainline, inadequate capacity at merge and diverge locations (on-ramps and off-ramps), and inadequate intersection capacity at ramp intersections with arterials and collectors.
- Year 2025 Projected traffic volumes entering and exiting the interstate indicate the need to add capacity to all 3 existing interchanges.
- Year 2025 Projected traffic volumes on the mainline and the high truck percentage indicate the need to widen the mainline from 6 to 10 lanes.
- Safety and capacity improvements will be enhanced by lengthening acceleration/ deceleration ramps, adding ramps and lanes, separating weaving movements on the mainline with collector-distributor (CD) roads, and upgrading bridges.

The findings highlighted issues of greatest concern within the study area, and the findings provided direction for the development of solutions to improve the interchanges with minor and major geometric modifications. While VDOT is addressing immediate concerns with short-term improvements such as additional signing and pavement markings and minor geometric improvements, longer-term projects to add substantial capacity along the mainline and at the interchanges will require significant investment by the Commonwealth.